

# FCC Reactor Overhead Line Vapor Isolation Valve

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# FCC Reactor Overhead Line Vapor Isolation Valve

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## ▸ Outline

- *What is a Reactor Overhead Line Vapor Isolation Valve*
- *Where is it located on a typical FCC unit*
- *Why install this valve on your unit*
- *Overview of key features*
- *Details of Internals*
  - *How does it work*
- *Purge*
- *Design considerations, methods and characteristics*
- *Reference List*
- *Questions*

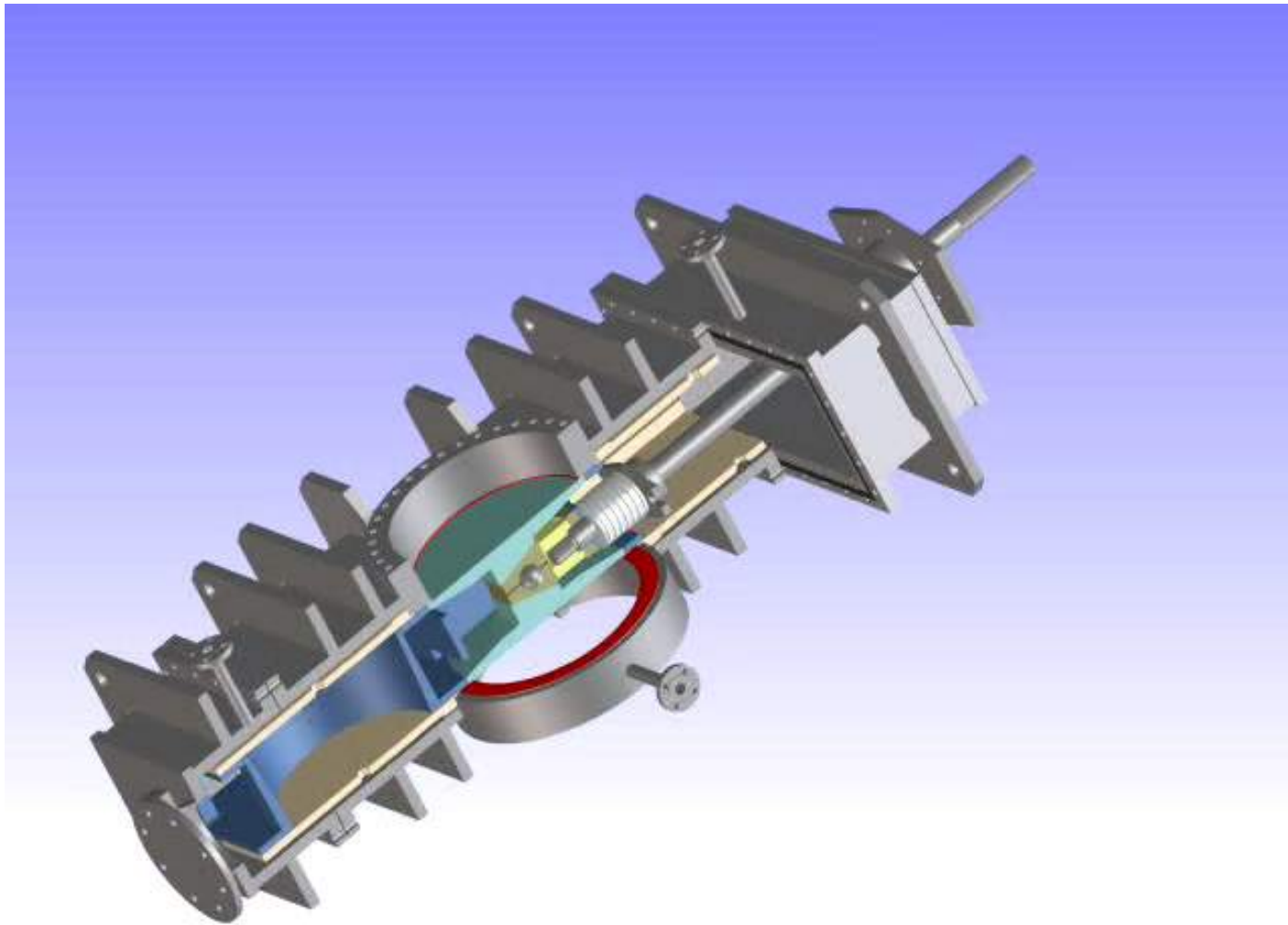
# What is a Reactor Overhead Line Vapor Isolation Valve

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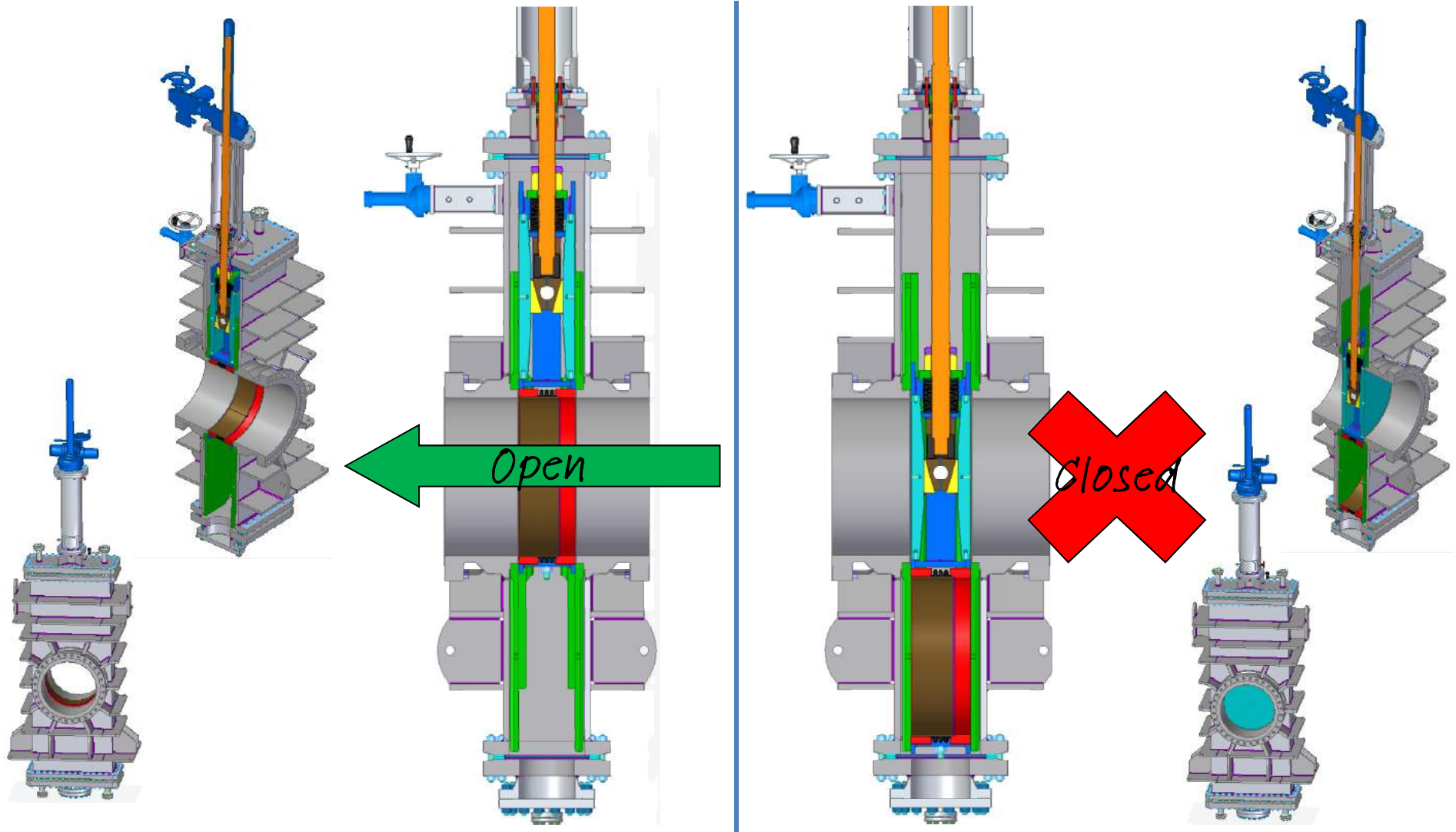


- ▶ Double Disc Through Conduit Gate Valve
  - ▶ *Valve has two separate, independent shut-off discs with an internal split-wedge-ball arrangement providing reliable operation and true double block & purge*
  - ▶ *Full or reduced bore port*
  - ▶ *Able to function in severe coking services*
- ▶ Corrosion and wear resistant weld overlay on all seats
- ▶ The seat surfaces are completely protected from the process flow when in the open or closed position
- ▶ Active and controlled mechanical sealing force due to split-wedge-ball arrangement
- ▶ The internal wedge-ball arrangement gives discs clearance to move and minimizes the seat-to-seat friction and wear
- ▶ Open throughway has movable seat rings to allow for better sealing in the open position (bellows) minimizing effect of seat deflections due to line loads
- ▶ Any type of actuator can be used:
  - ▶ *Closed position: torque seated (torque switch); open position: position seated (limit switch)*
- ▶ Patented design

# What is a Reactor Overhead Line Vapor Isolation Valve



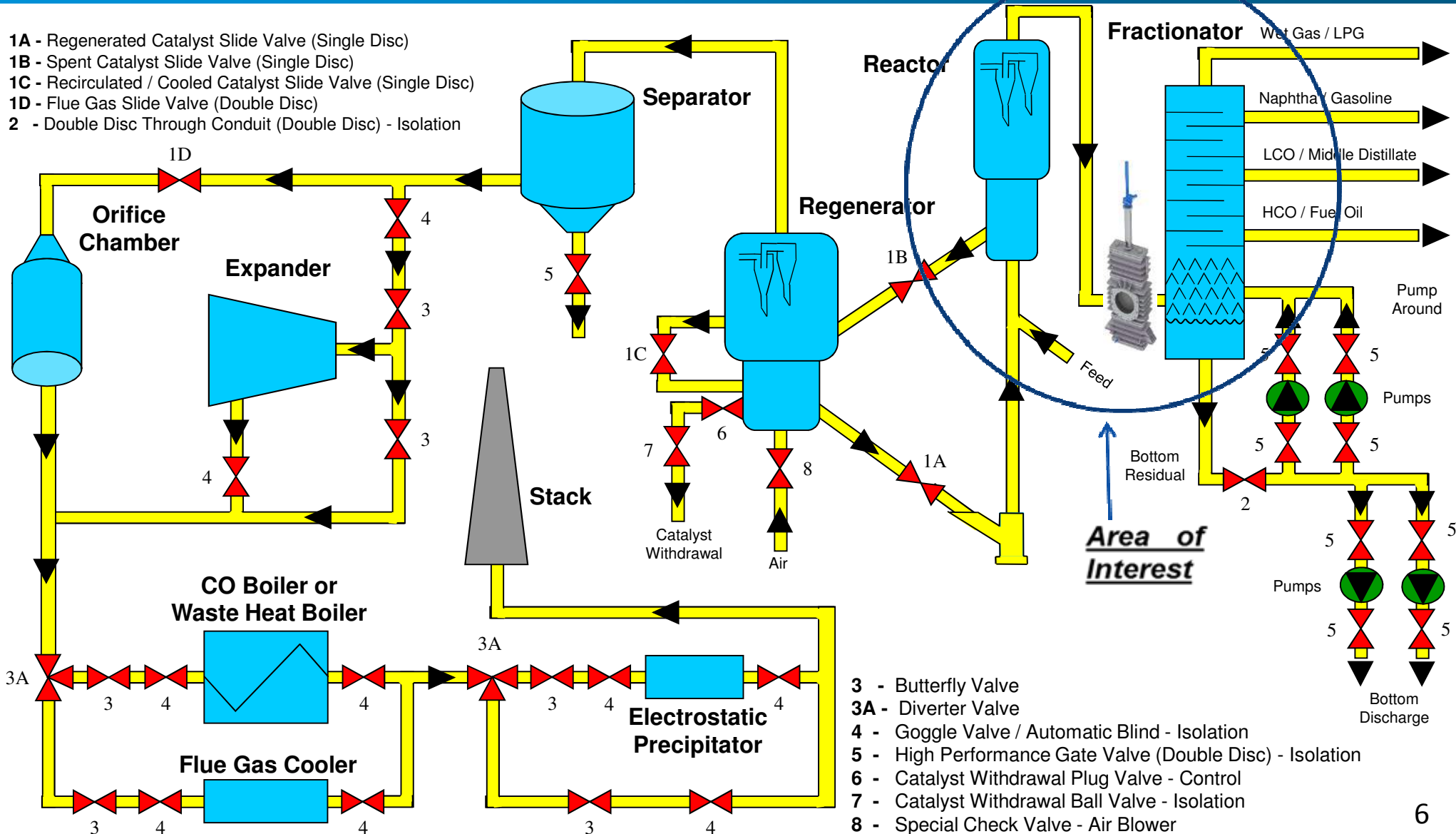
# What is a Reactor Overhead Line Vapor Isolation Valve



# Where is it Located on a Typical FCC Unit

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- 1A - Regenerated Catalyst Slide Valve (Single Disc)
- 1B - Spent Catalyst Slide Valve (Single Disc)
- 1C - Recirculated / Cooled Catalyst Slide Valve (Single Disc)
- 1D - Flue Gas Slide Valve (Double Disc)
- 2 - Double Disc Through Conduit (Double Disc) - Isolation



# Why Install it on YOUR Unit

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- ▶ **Safety**

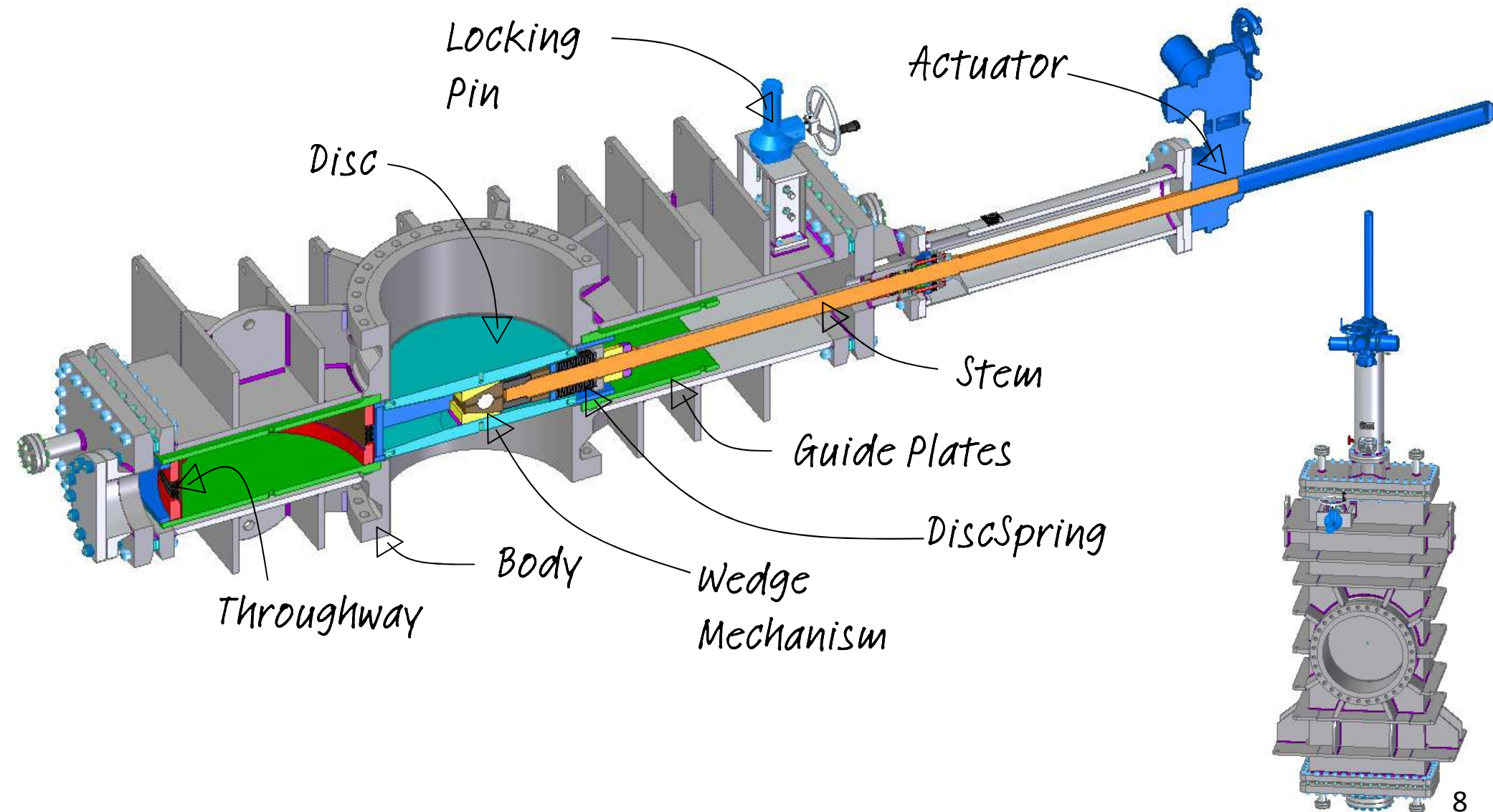
- ▶ *Takes personnel out of the line of fire*
- ▶ *Allows for much safer conditions during fractionator blinding operations*
- ▶ Quick Isolation of the Reactor from the Fractionator
  - ▶ *Valve can be stroked in minutes vs. hours or shifts*
- ▶ Shortens Critical Path of Turnaround during Shutdown and Startup
  - ▶ *No need to cool down to isolate during shutdown*
  - ▶ *Continue startup without delay after refractory curing*



# Overview of Key Features

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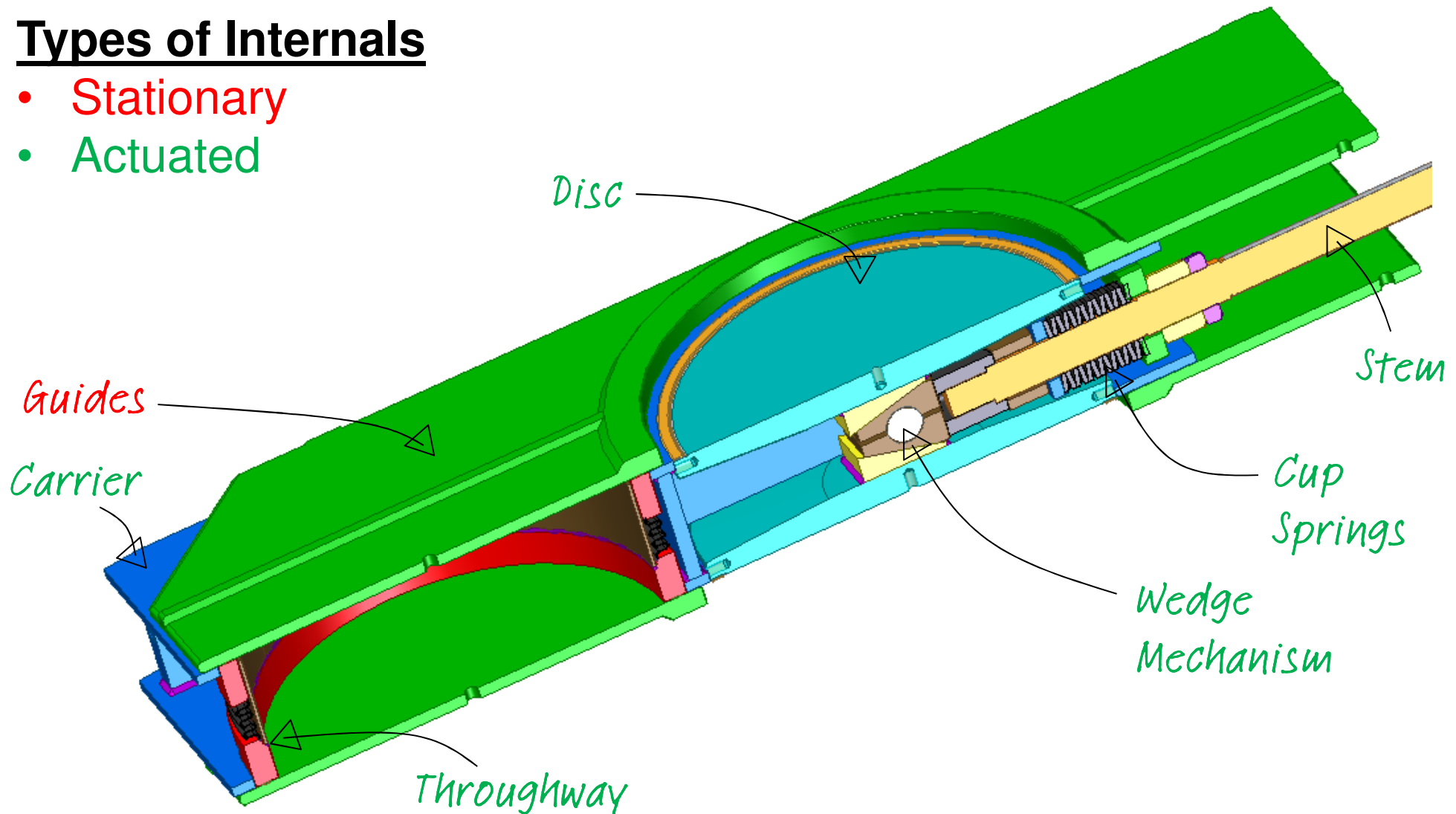


# Overview of Key Features

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## Types of Internals

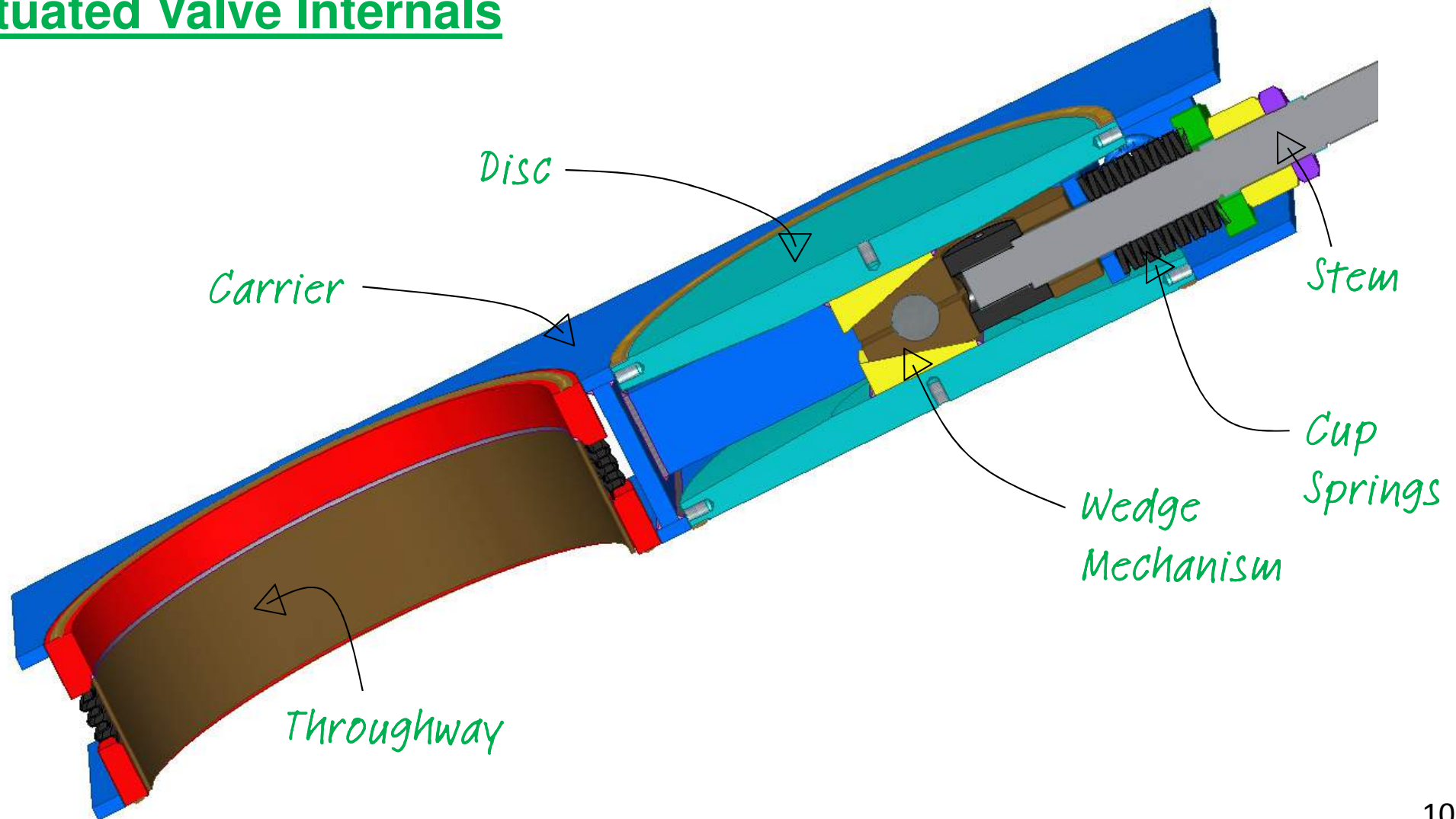
- Stationary
- Actuated



# Overview of Key Features

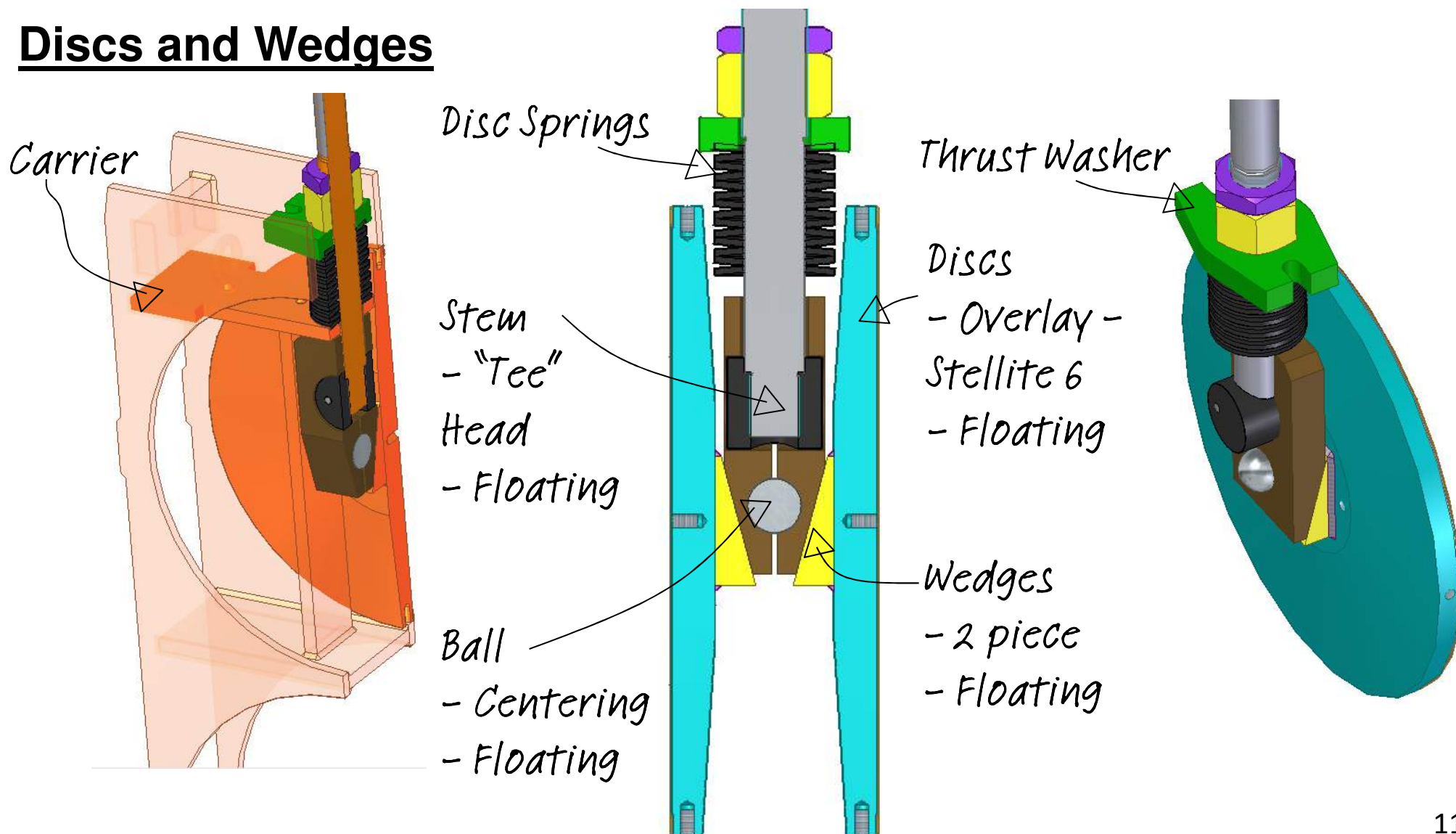
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## Actuated Valve Internals



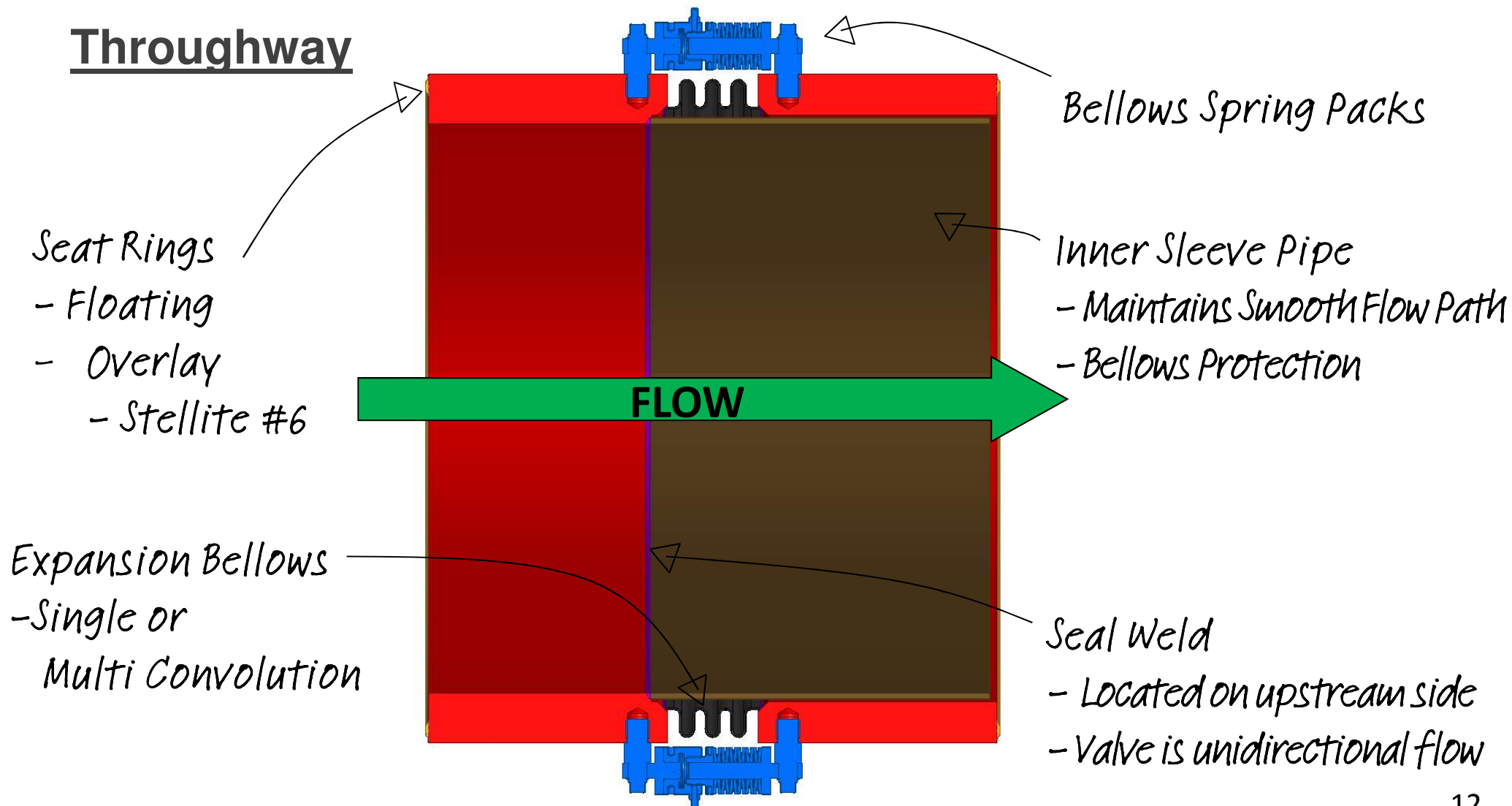
# Overview of Key Features

## Discs and Wedges



# Overview of Key Features

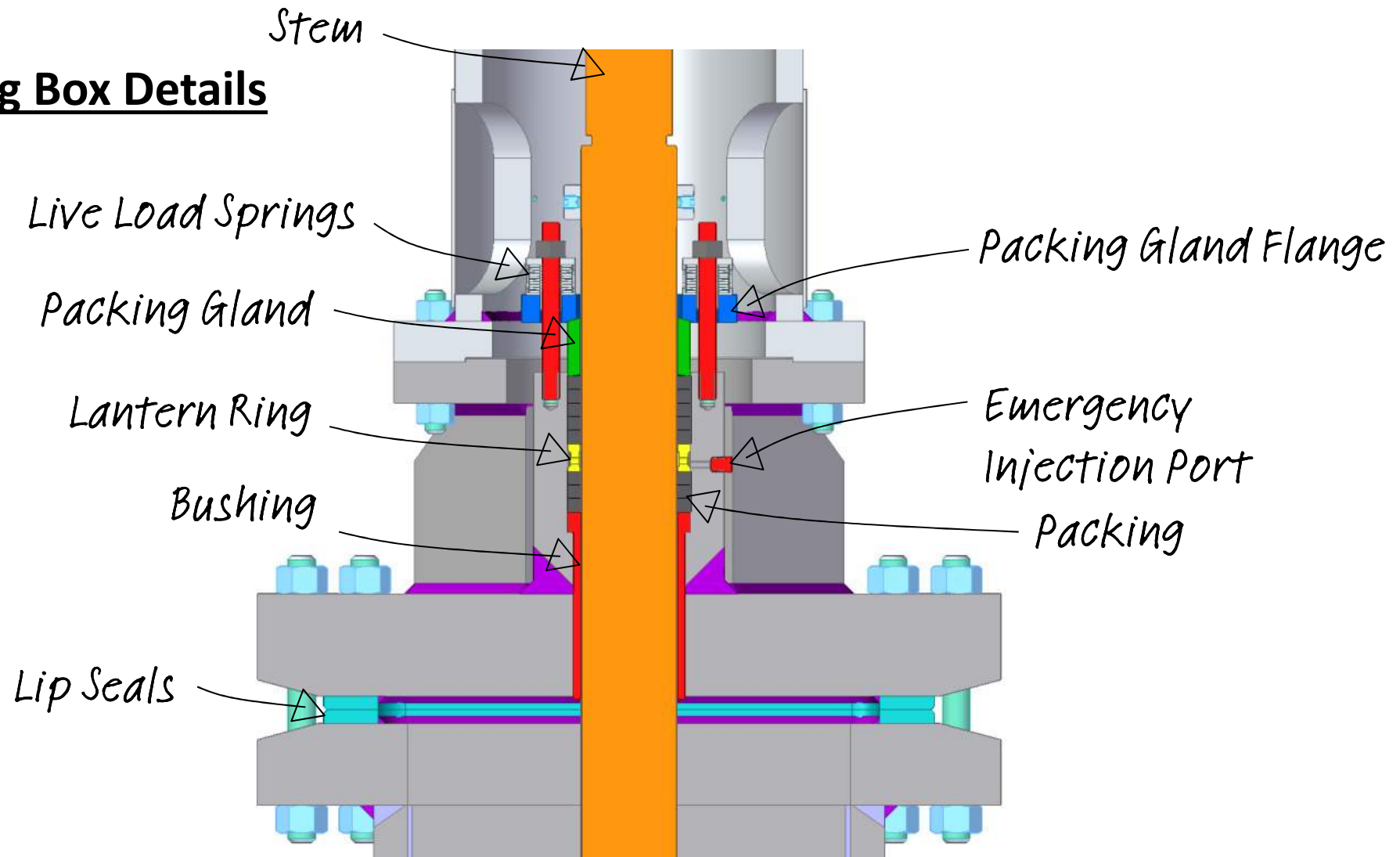
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# Overview of Key Features

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## Stuffing Box Details





# Overview of Key Features

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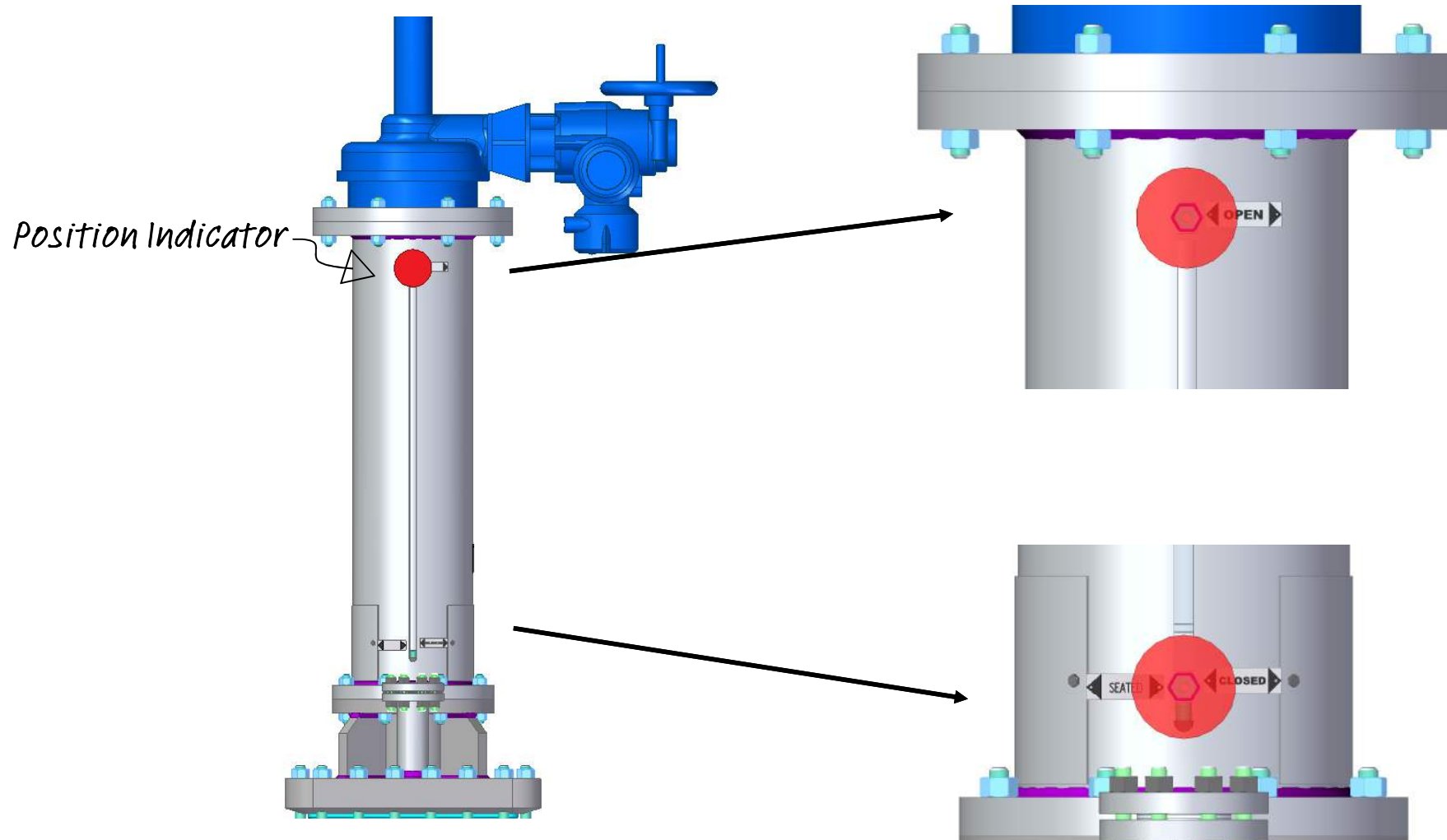
*Locking Pin*

## Locking Pin Details

*Locking Pin*

*Hole in Carrier*

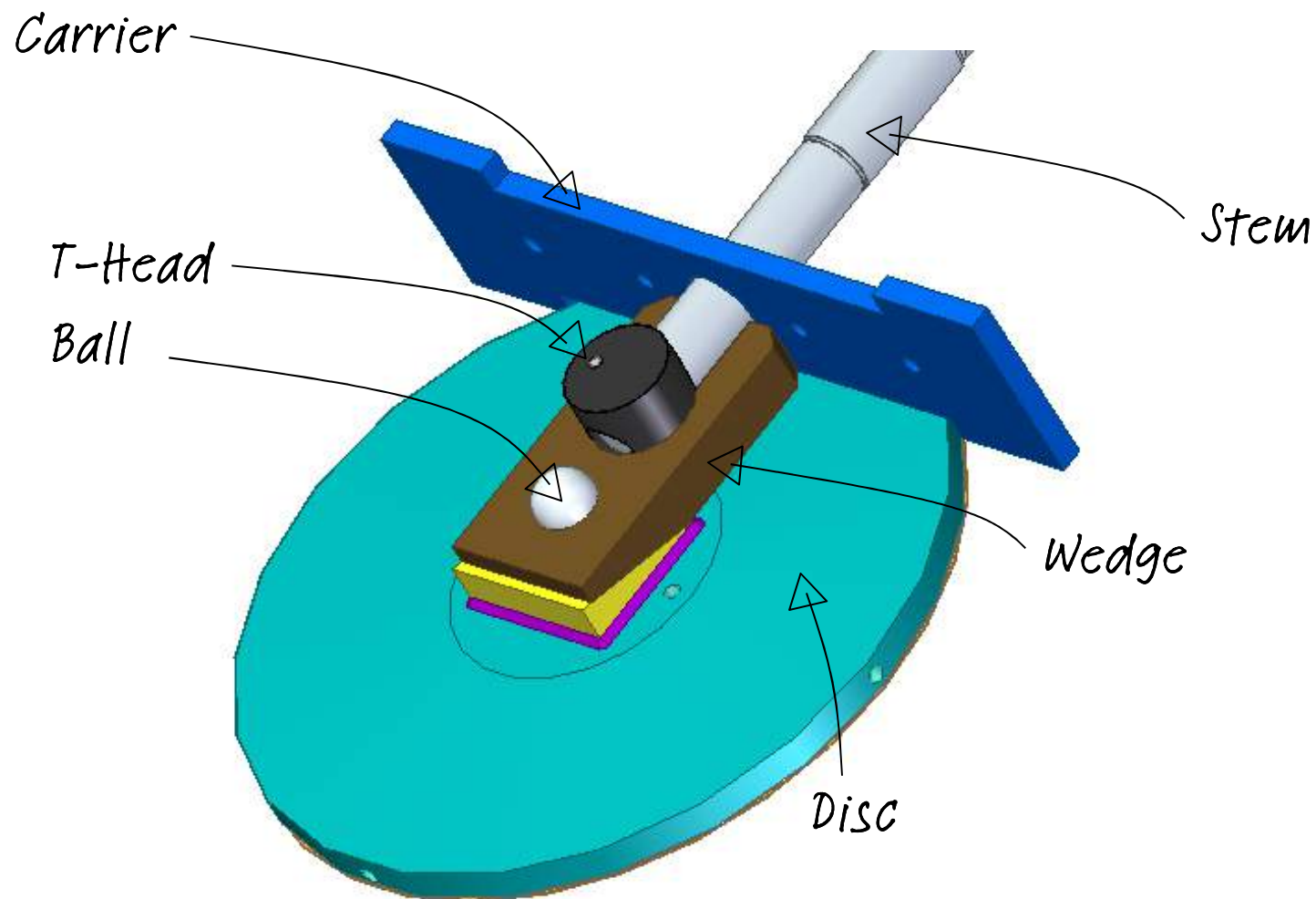
# Position Indicators





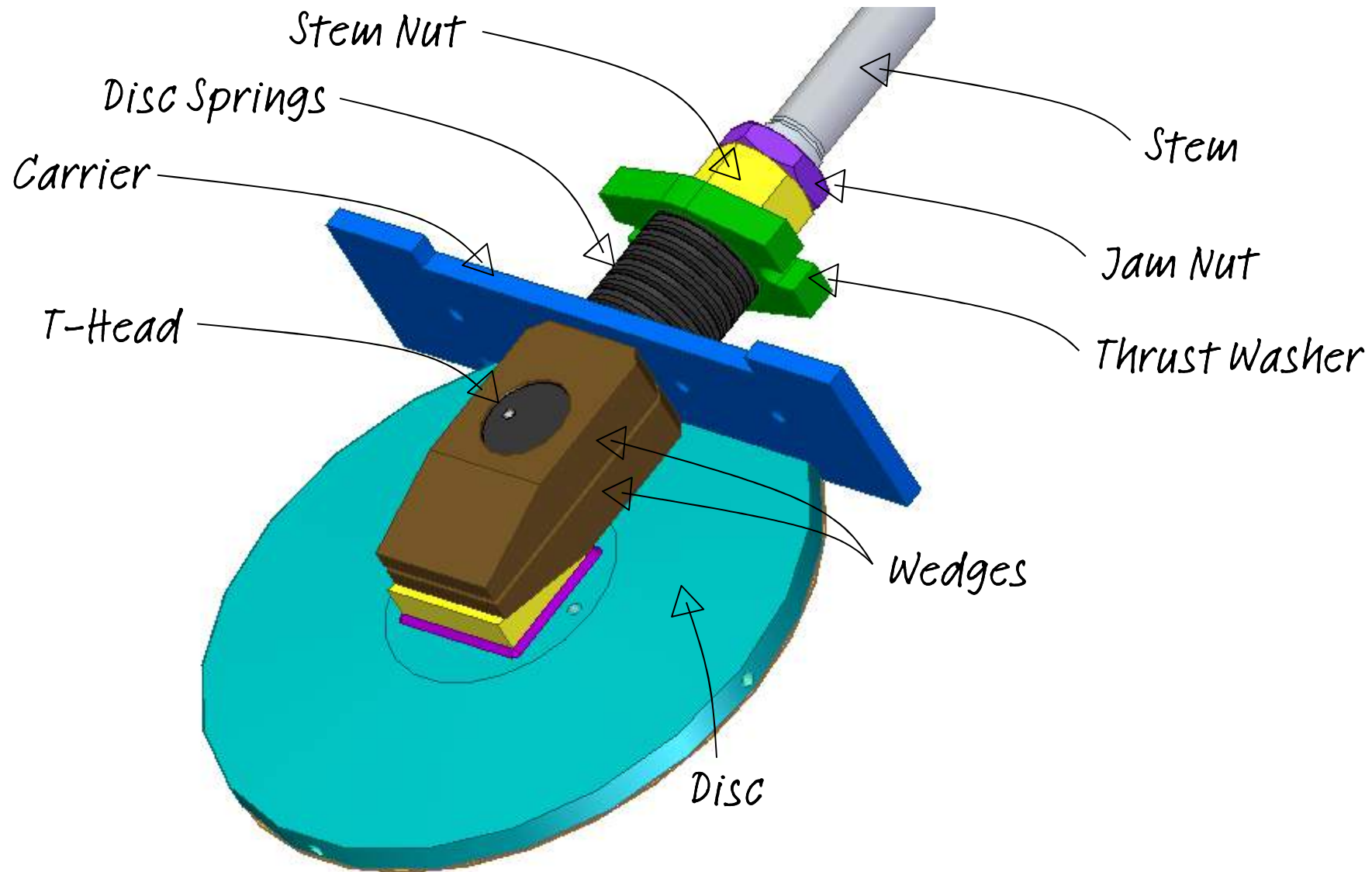
# Details of Internals

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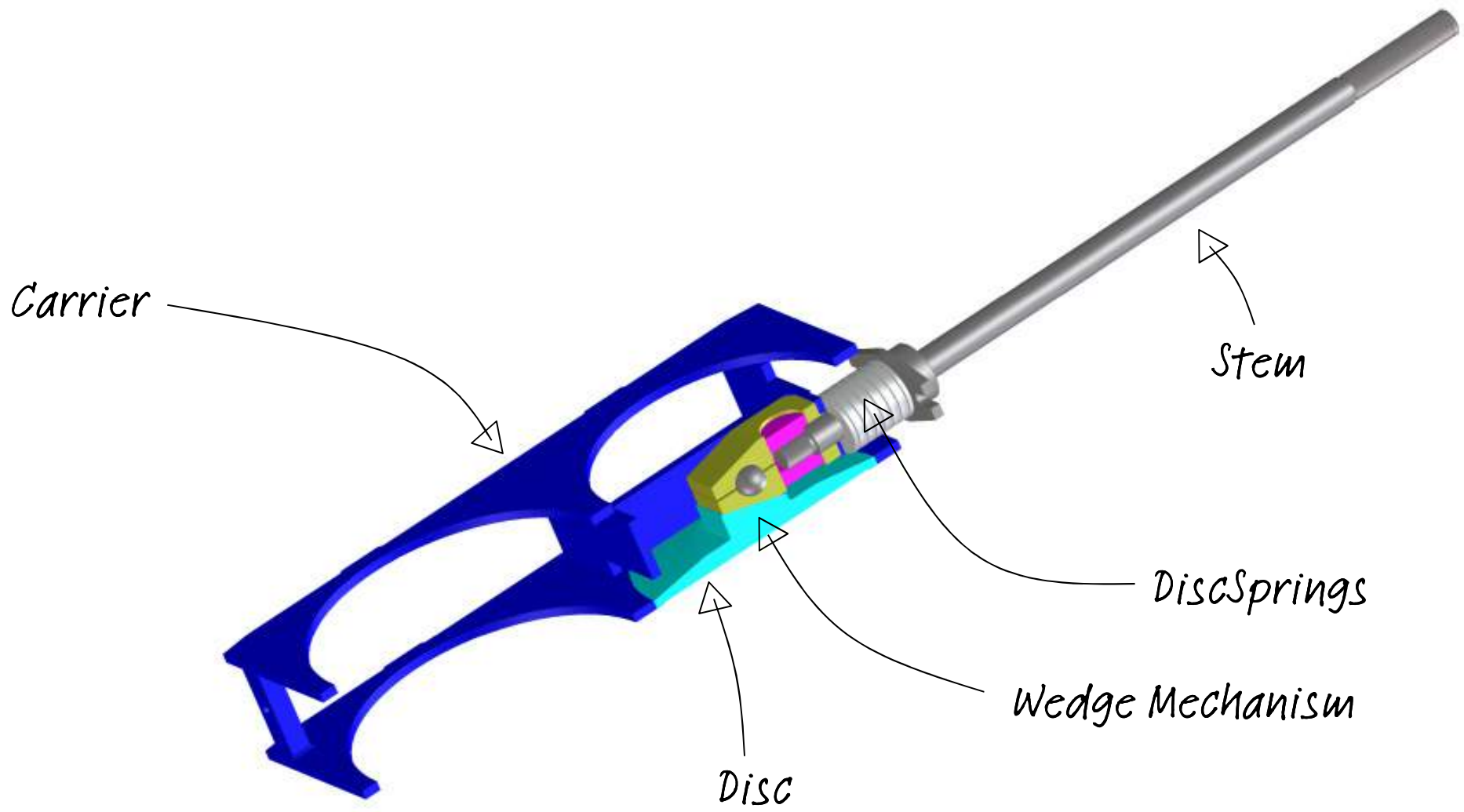
# Details of Internals

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# Details of Internals

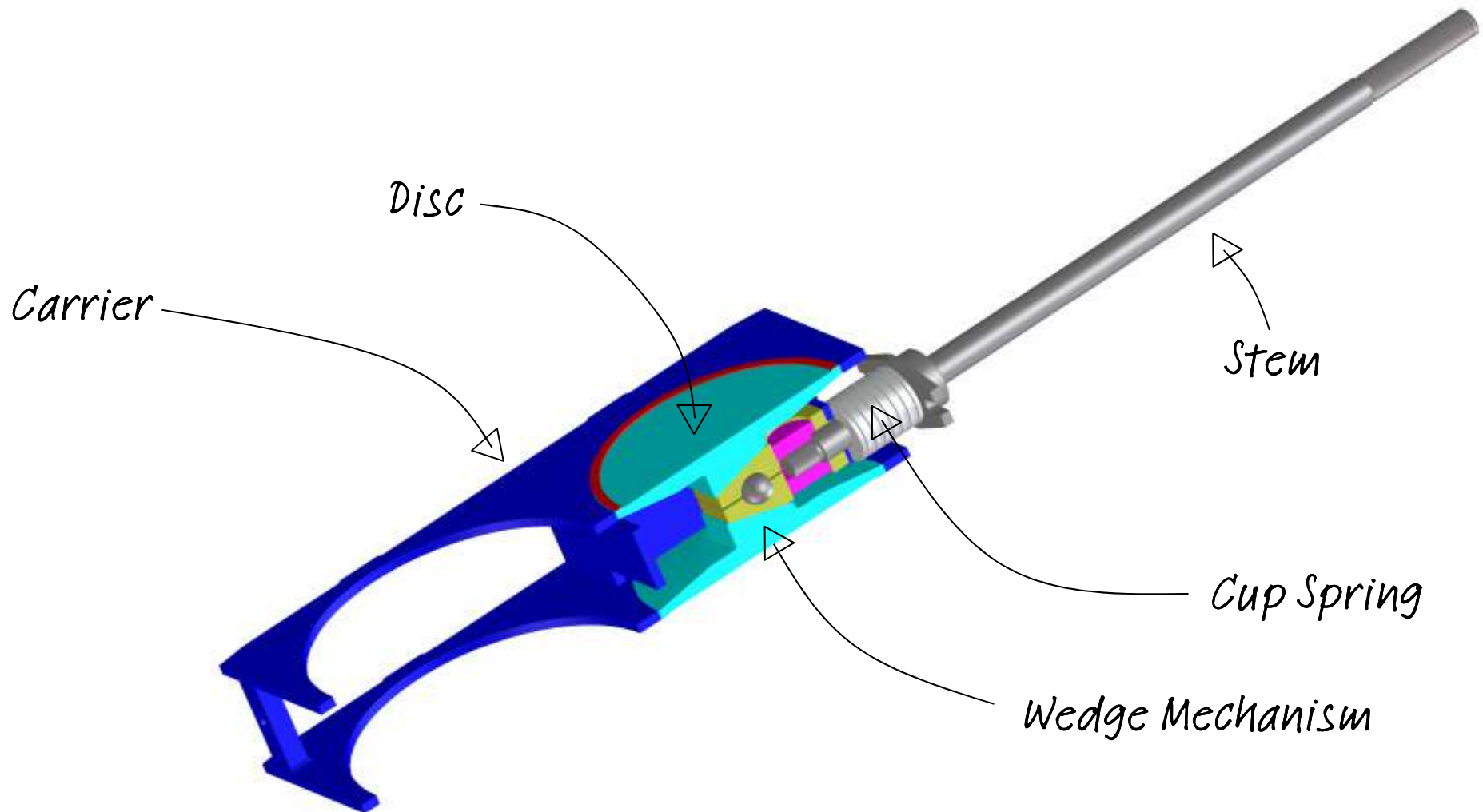
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# Details of Internals

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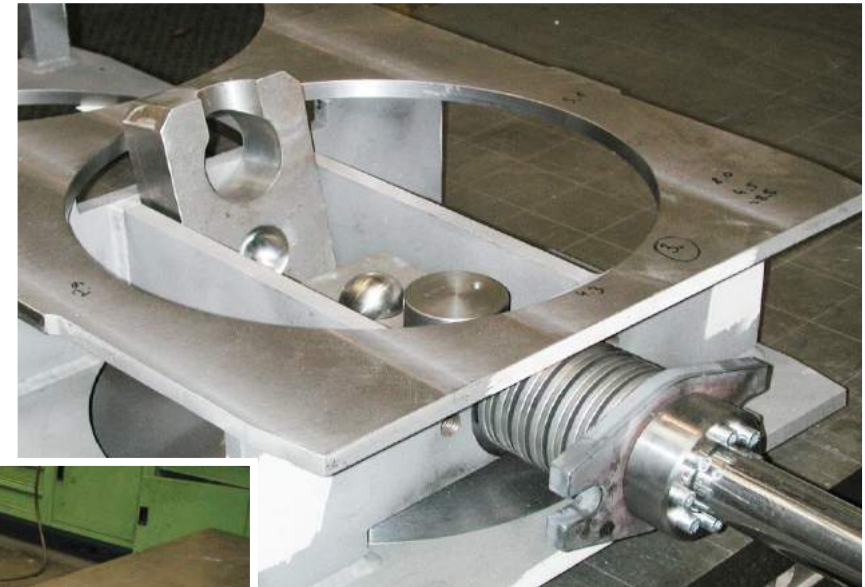
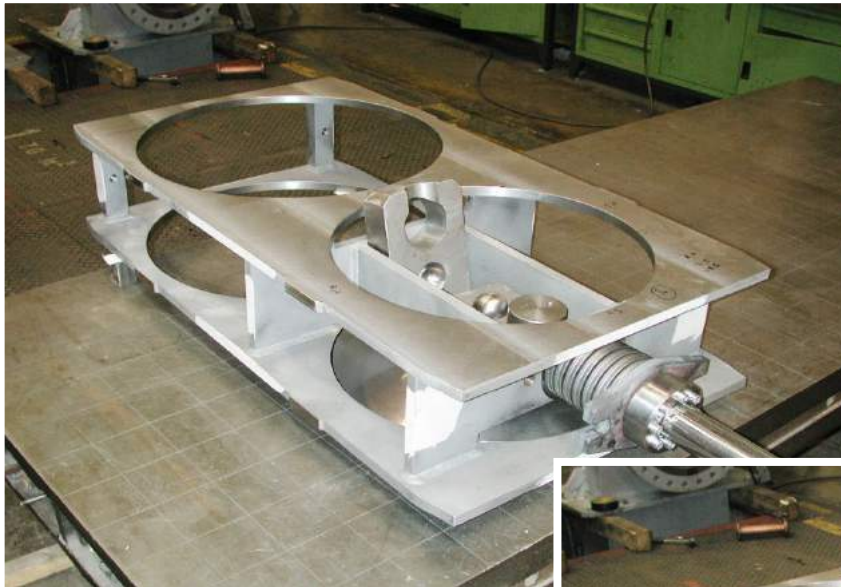


# Details of Internals

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## Discs and Wedges





# Details of Internals

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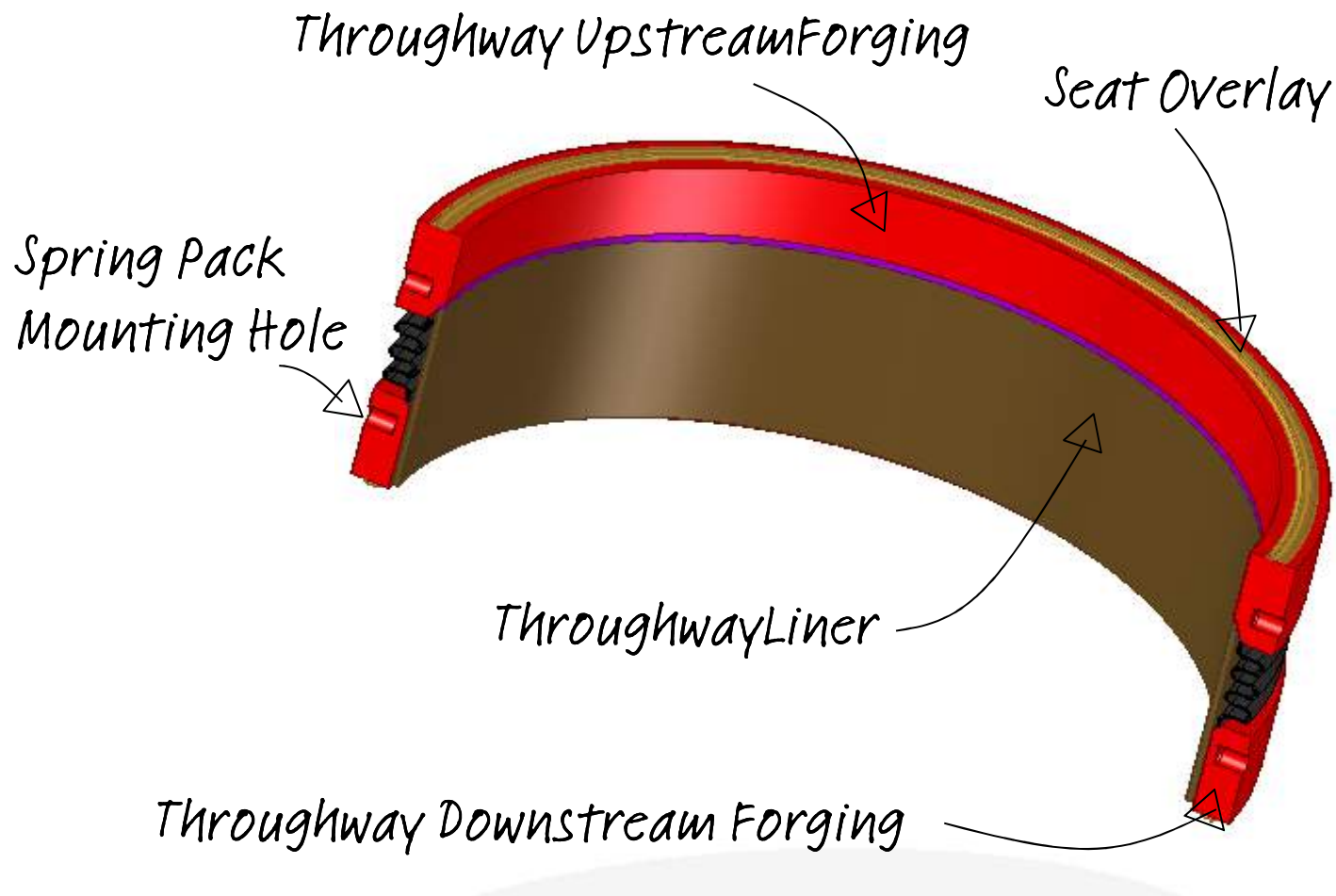
## Throughway



# Details of Internals

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## Throughway

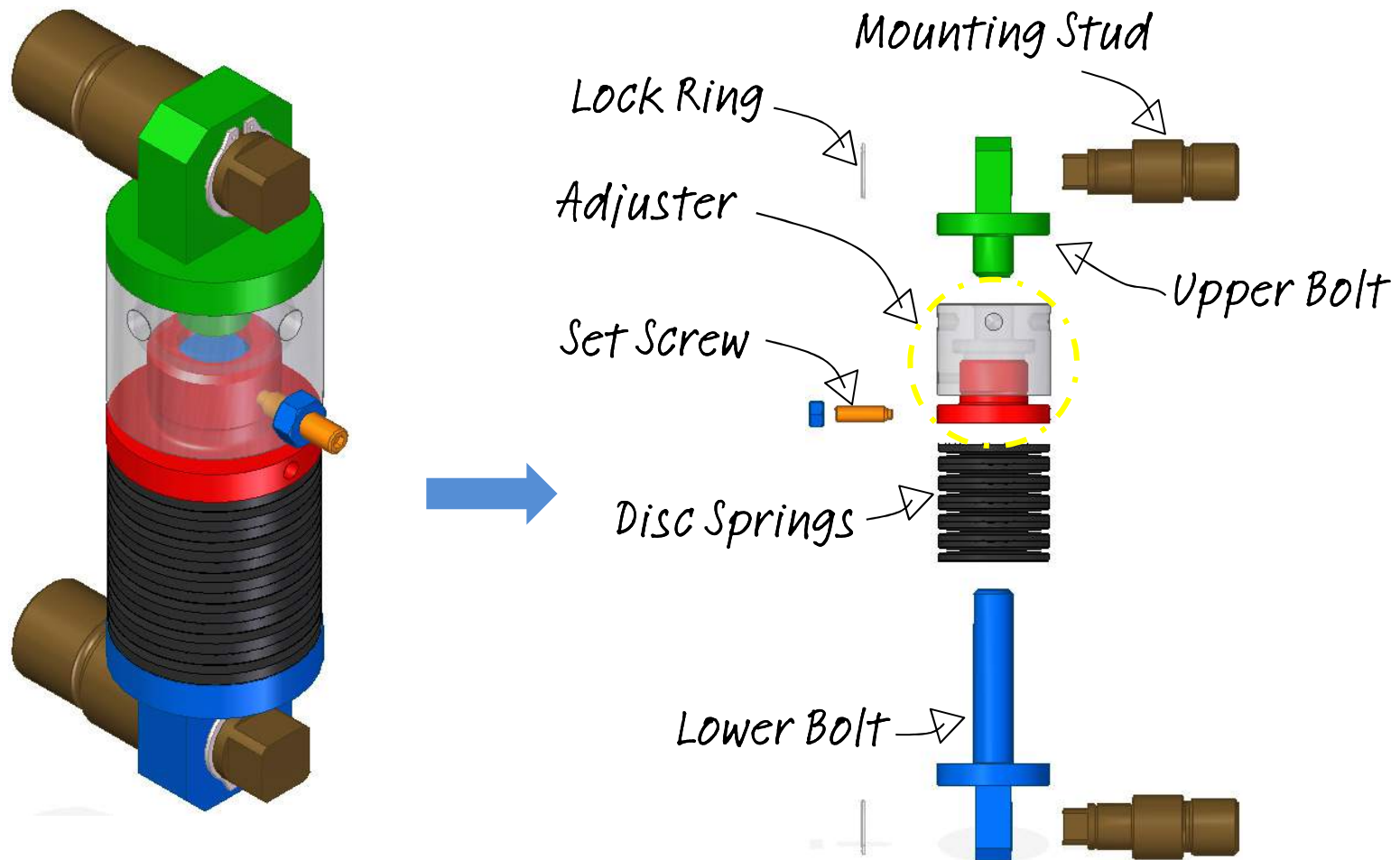




# Details of Internals

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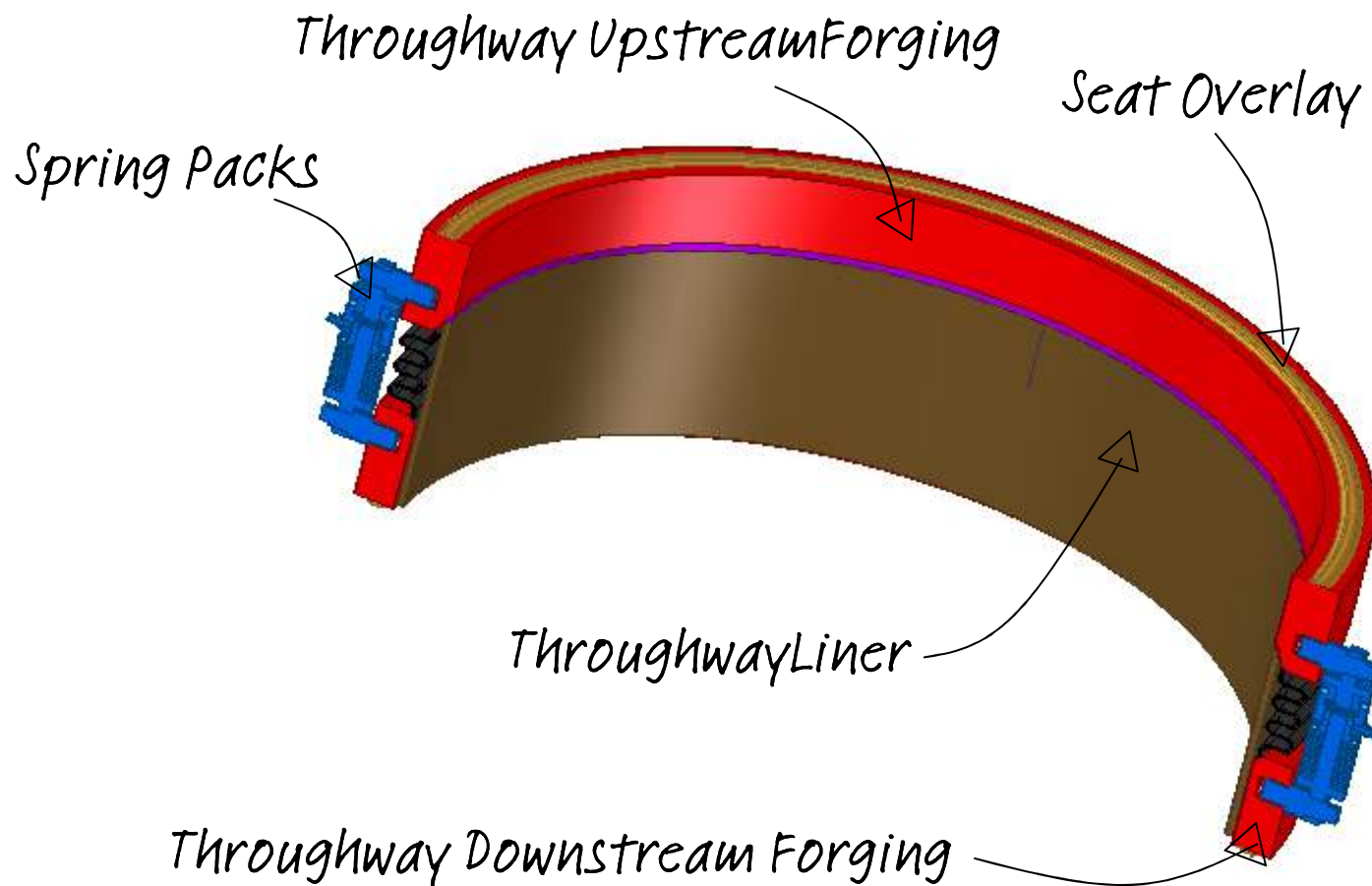
## Throughway Spring Pack



# Details of Internals

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## Throughway

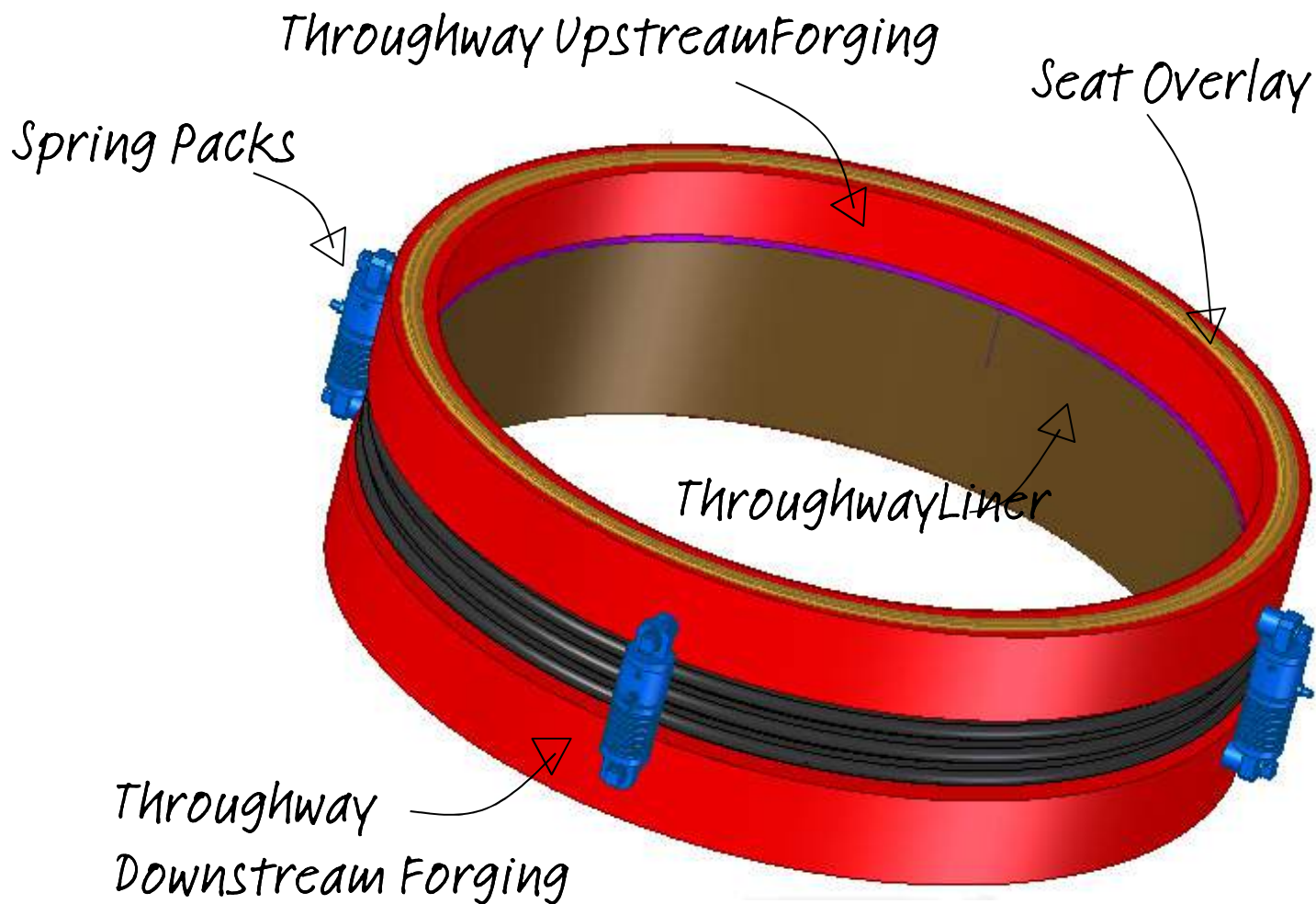


# Details of Internals

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## Throughway



# Details of Internals

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## Bellows Sleeve

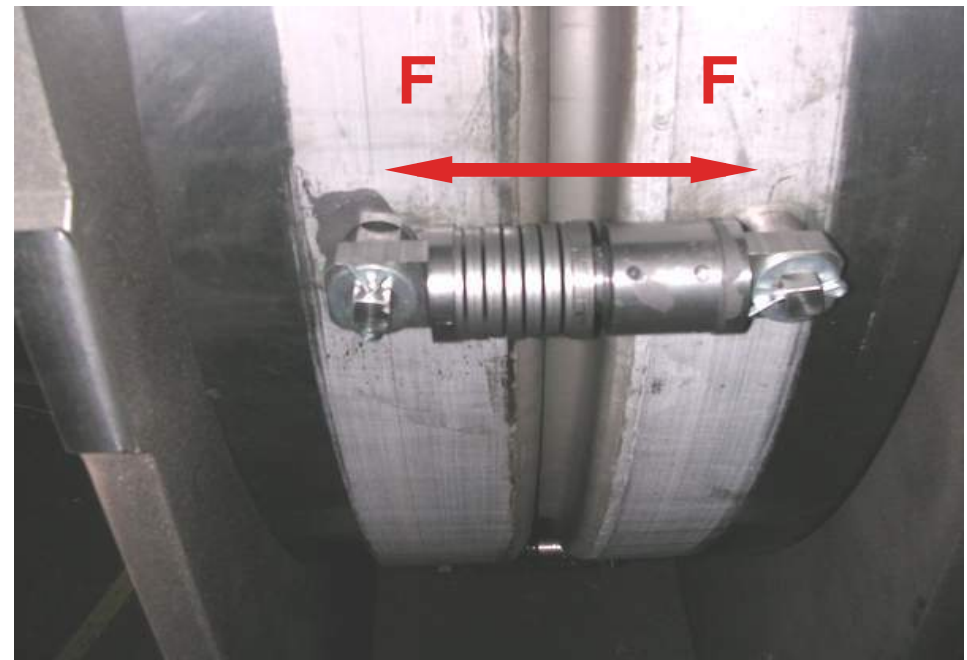
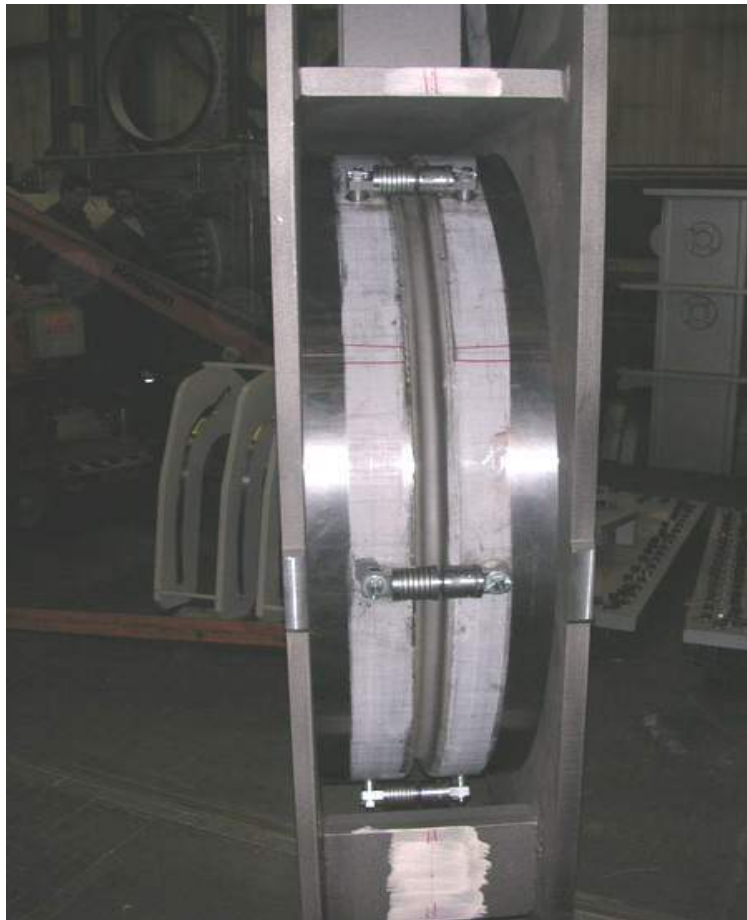


# Details of Internals

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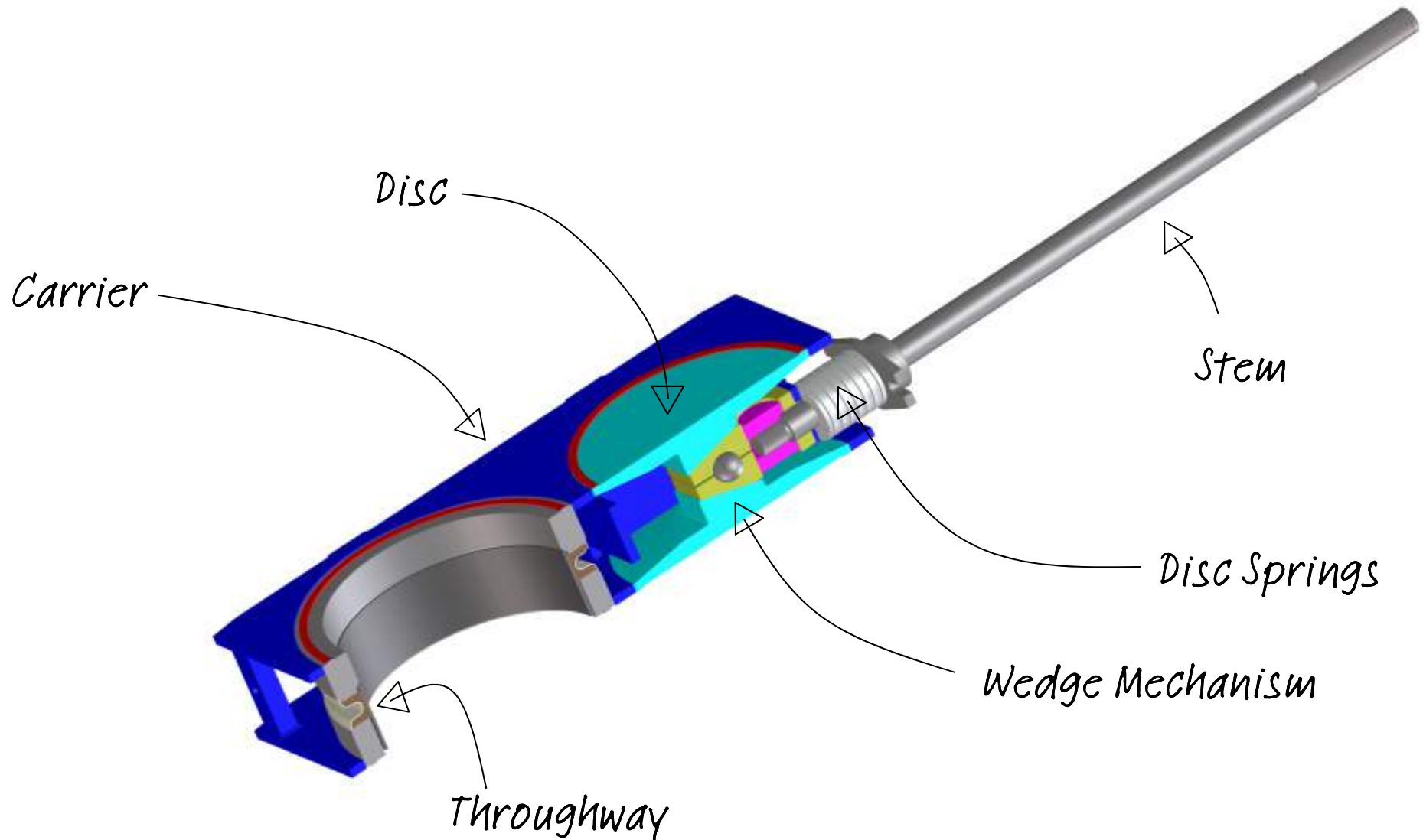
## Throughway Live Loading Bellville Washer Spring Assemblies





# Details of Internals

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# Details of Internals

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## Carrier for Discs and Throughway Assemblies

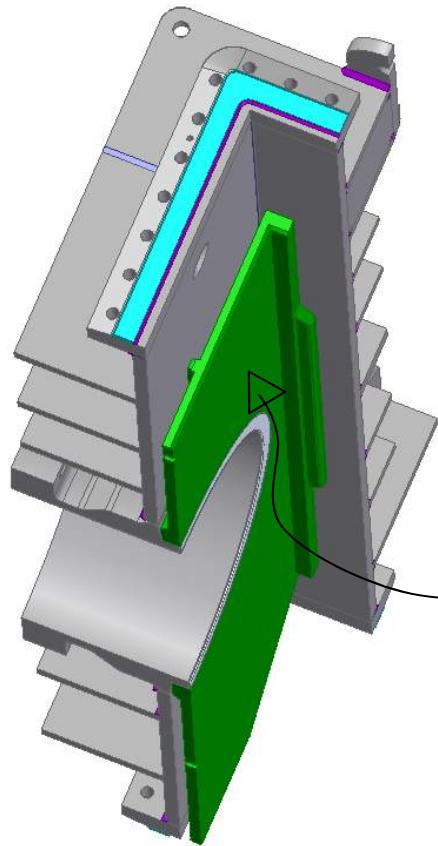




# Details of Internals

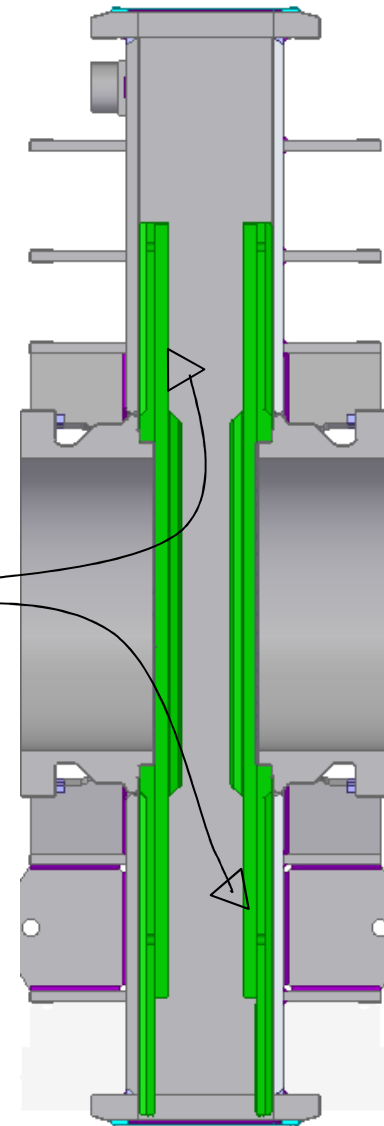
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## Stationary Valve Internals



Guide Plates  
-Free Floating  
on Body Bosses

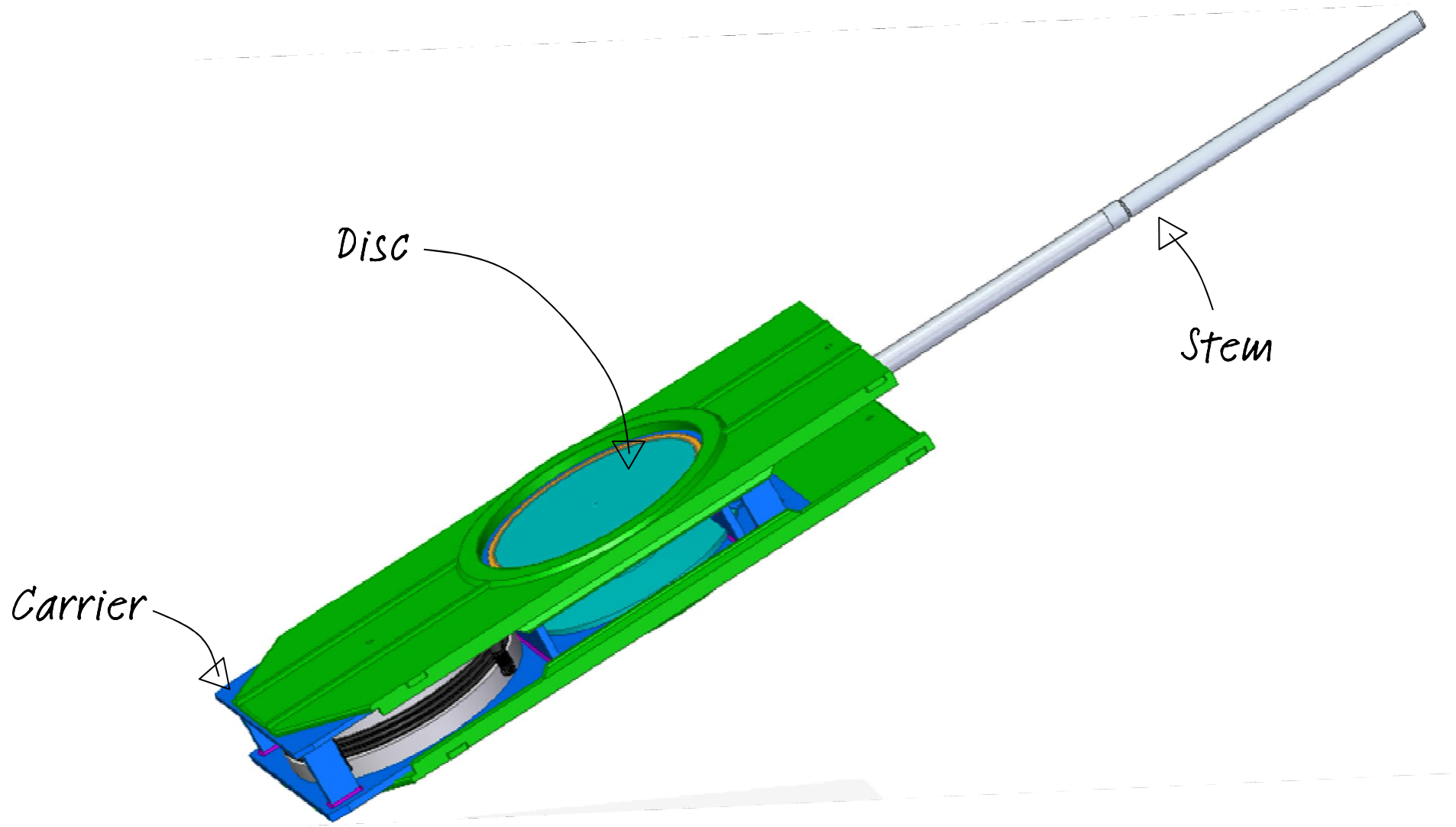
Guide Plates



# Details of Internals

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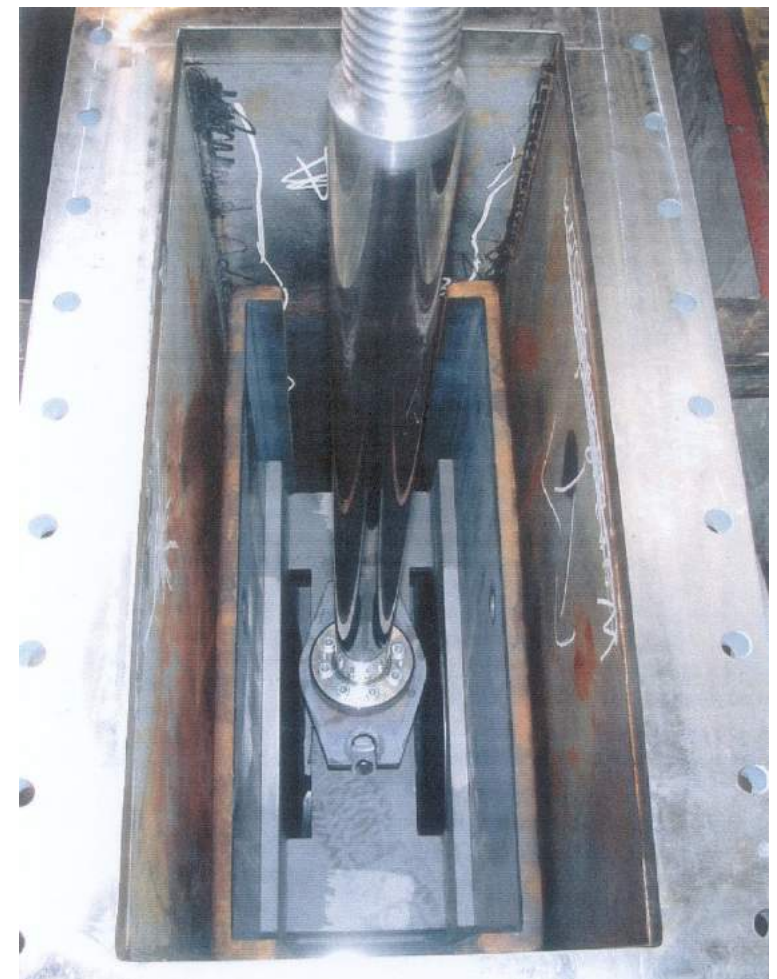
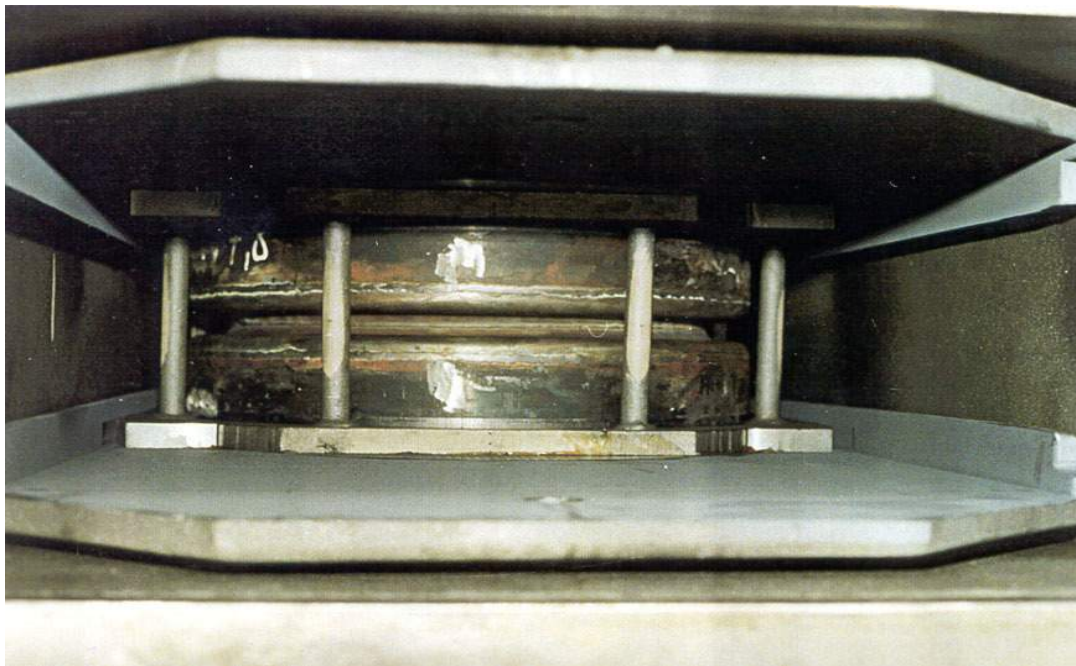


# Details of Internals

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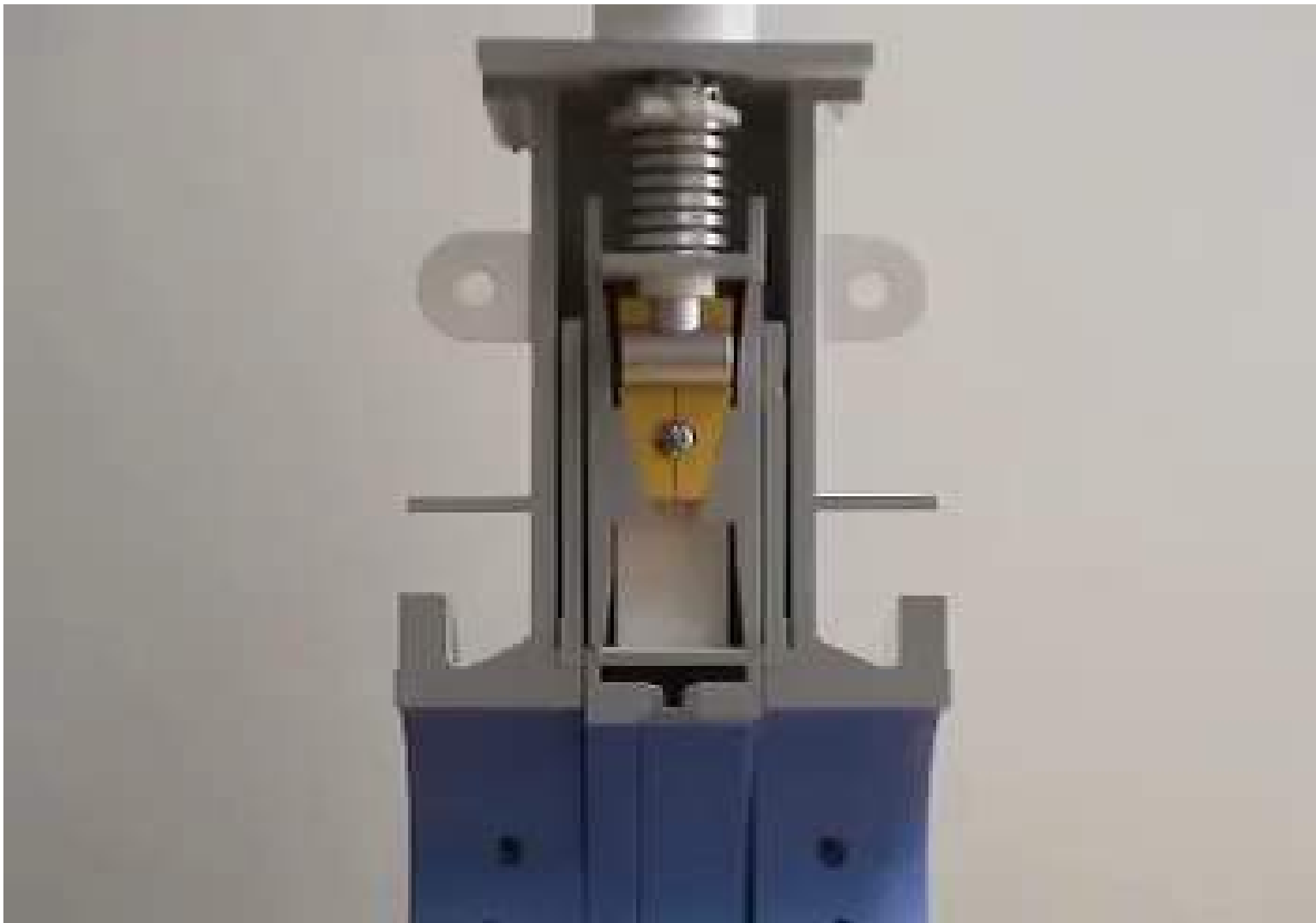
## Internals Installed in the Body



# Details of Internals

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# Purge

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- ▶ Permanent & continuous purge flow through the valve body must be maintained under all process conditions
  - ▶ *Open*
  - ▶ *Closed*
  - ▶ *Stroking*
- ▶ The purge pressure shall be throttled and maintained at approximately 7 psi above the operating process pressure for the following reasons:
  - ▶ *Avoids particle entry into the valve body and prevents build-up on internal parts in the open position*
  - ▶ *Provides additional sealing against leakage in the closed position (double block and purge)*
  - ▶ *Maintains the valve body cavity free of debris so that the valve can stroke freely*
- ▶ Purge media is typically superheated steam or N2
- ▶ Purge steam pressure shall never exceed the design pressure of the body.



# Design Considerations, Methods and Characteristics

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- Mitigation against coking of the internal working components
- Protecting seats from Erosion & Coking while the valve is in the open position
- Valve body must be designed to resist line loads
- Double Block & Purge Isolation to allow for the quick / safe installation of a blind
- Typical mounting orientation – Valve: Vertical Stem, Line: Horizontal
- Valves can range in size from 6” to 100”
- Pipe installation connections: Welded or Flanged
- Materials of construction are based on customer specifications and design conditions
- Cast refractory and/or erosion resistant lining can be used to further protect the valve body and throughway
- Valve sealing performance.

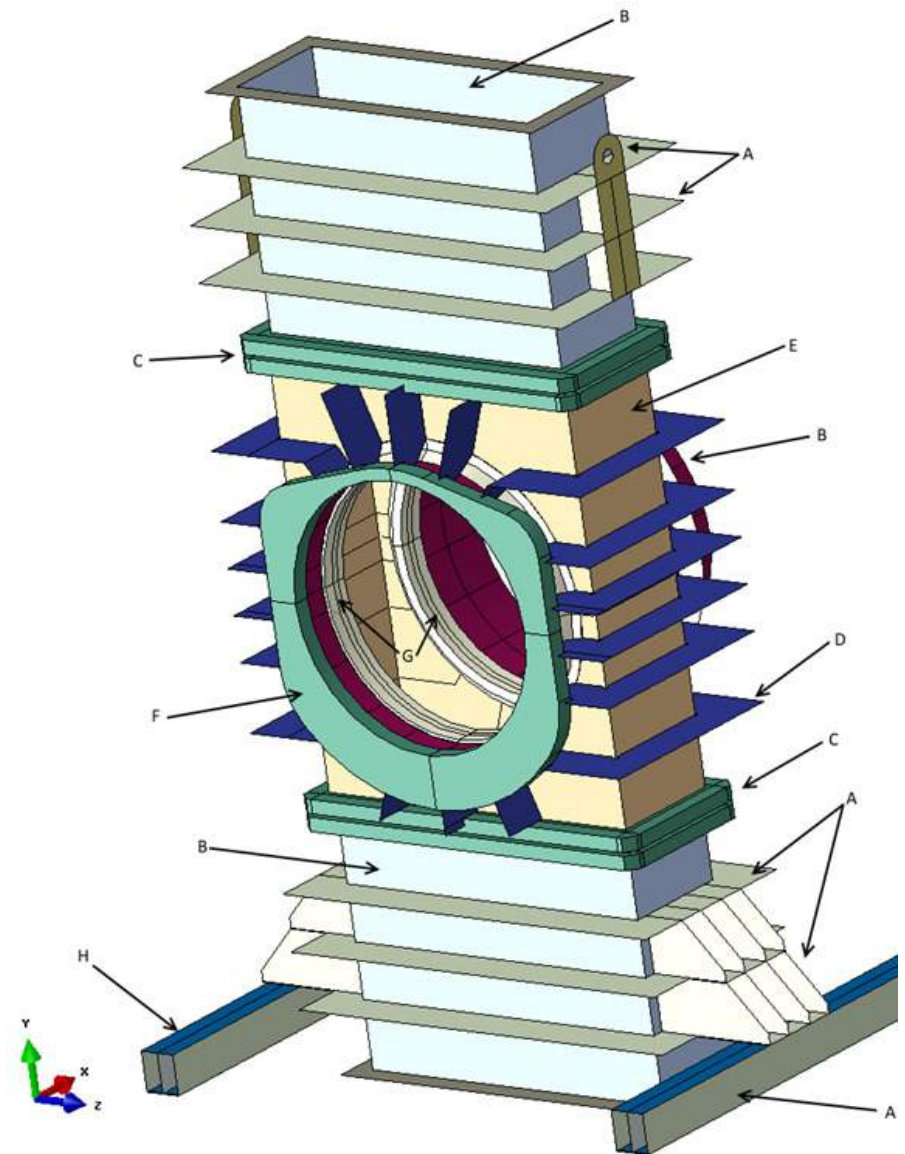


# Design Considerations, Methods and Characteristics

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## Typical Materials

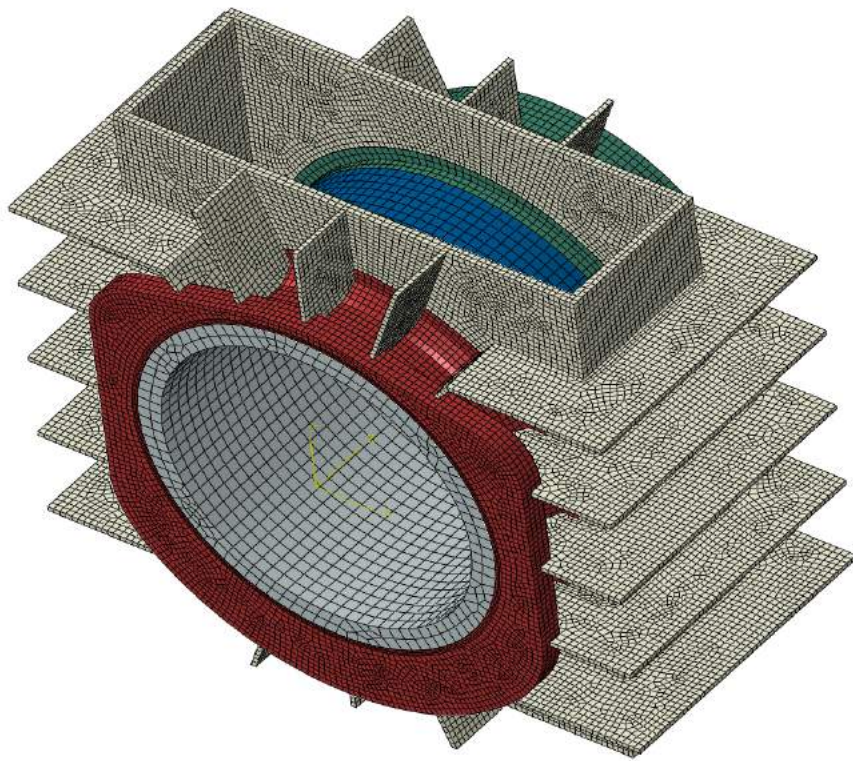
Label	Description
A	SA-516 Gr 70; shell; 1 inch; no corrosion
B	SA-516 Gr 70; shell; 1 inch; 1/16 inch corrosion
C	SA-516 Gr 70; 1/16" CA removed on ID surfaces solid
D	SA-387 Gr 11 CL2; shell; 2 inch; no corrosion
E	SA-387 Gr 11 CL2; shell; 2 inch; 1/16 inch corrosion
F	SA-105; 1/16" CA removed on ID surfaces solid
G	SA-182 F11 CL2; 1/16" CA removed on ID surfaces solid
H	SA-36; see Figure 3; no corrosion



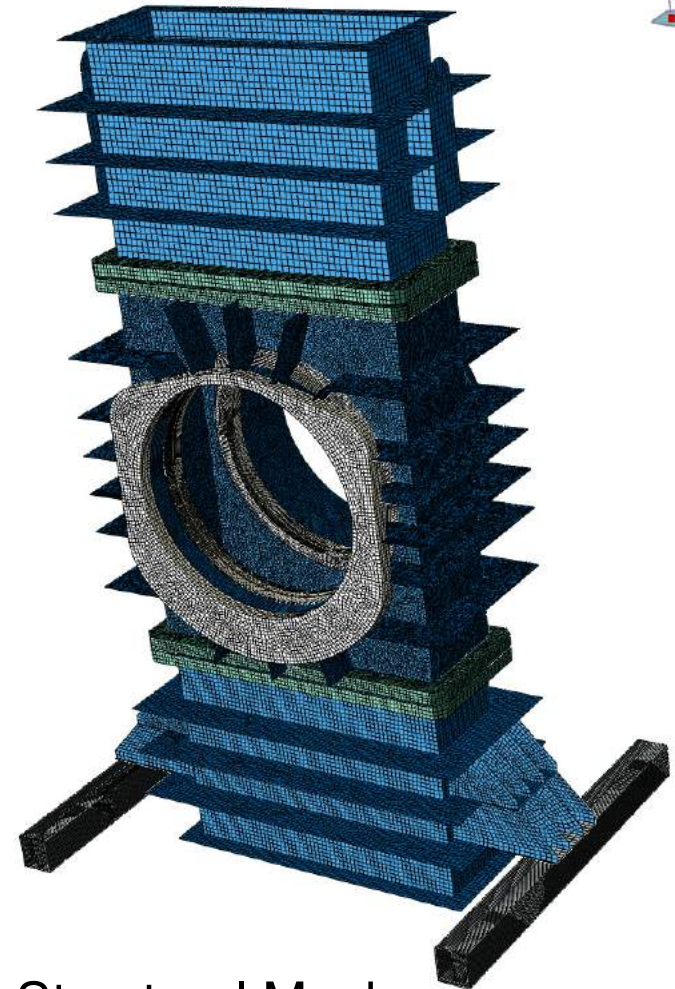
# Design Considerations, Methods and Characteristics

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Thermal Mesh



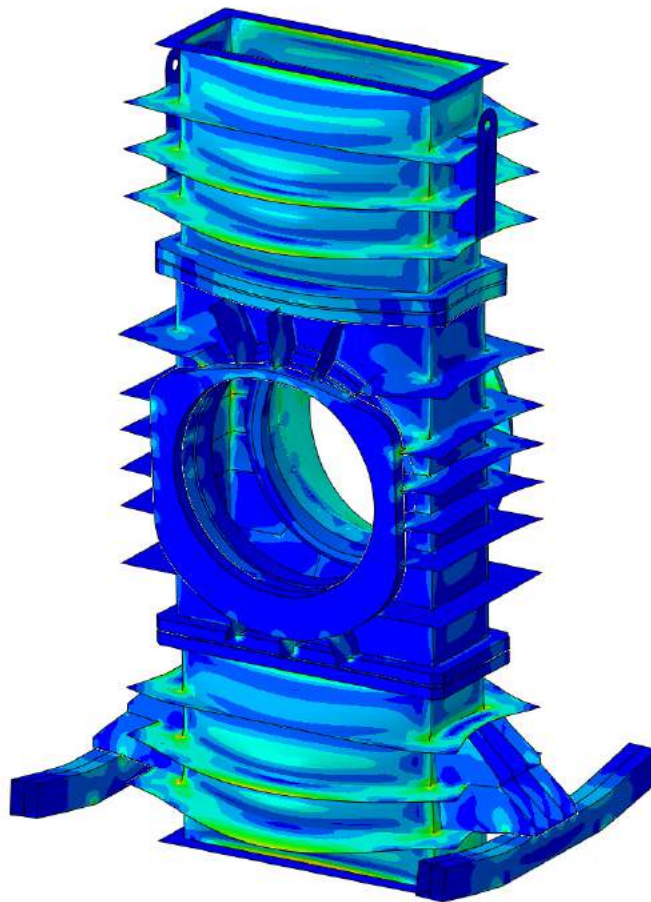
Structural Mesh



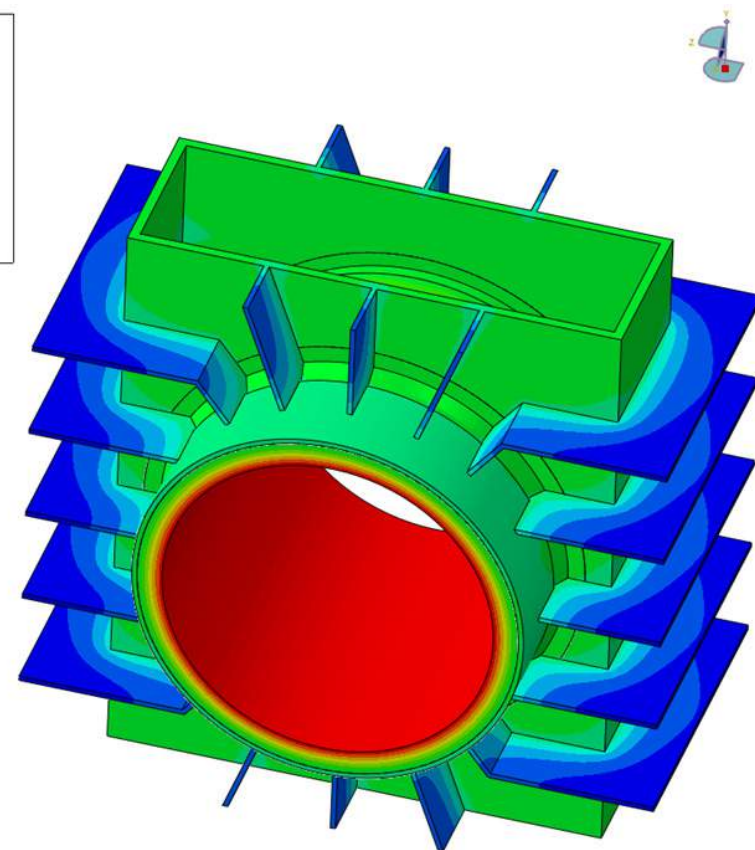
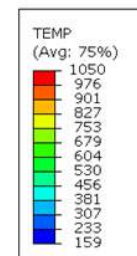
# Design Considerations, Methods and Characteristics

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## Finite Element Results

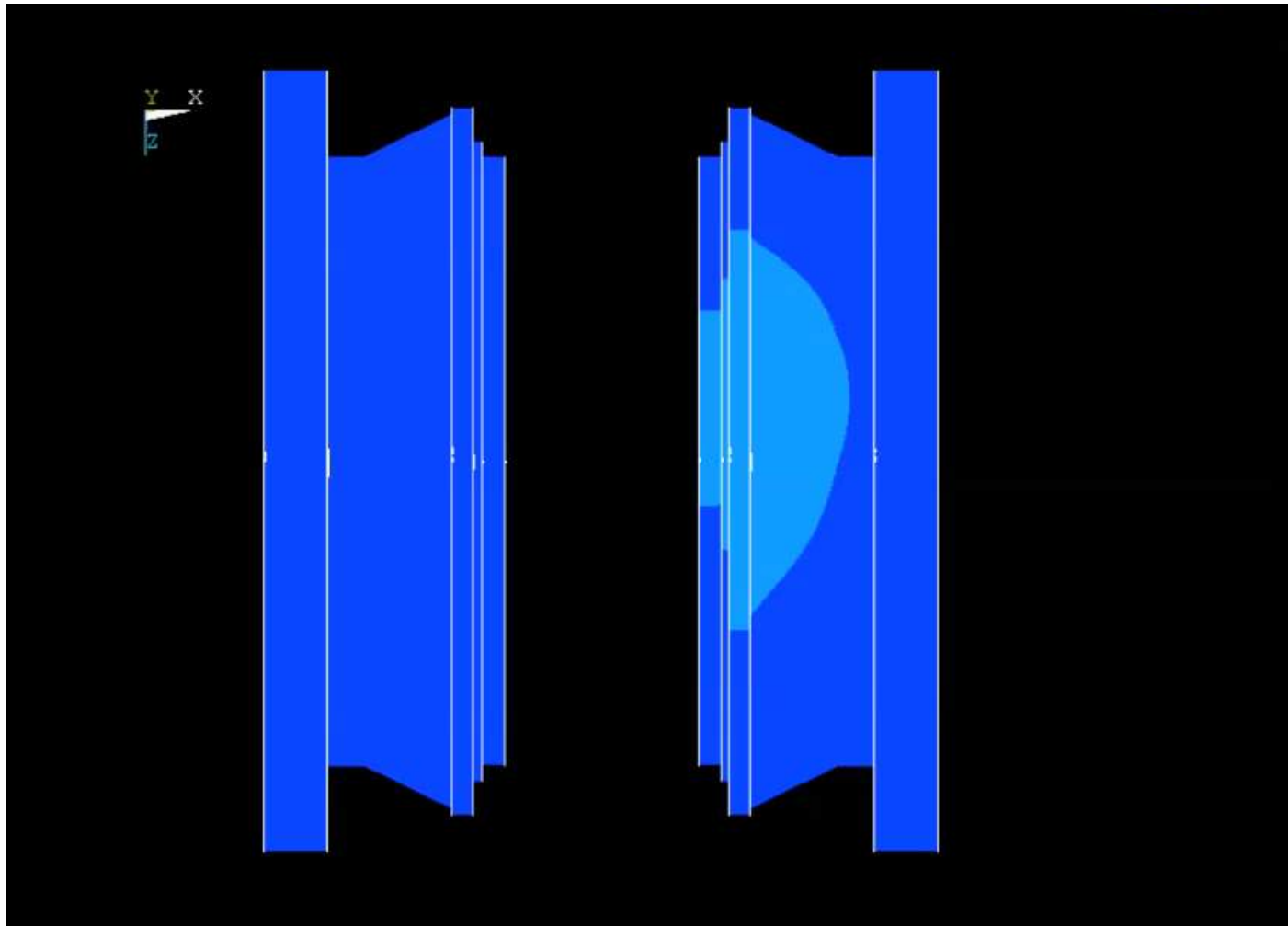


Stress Profile



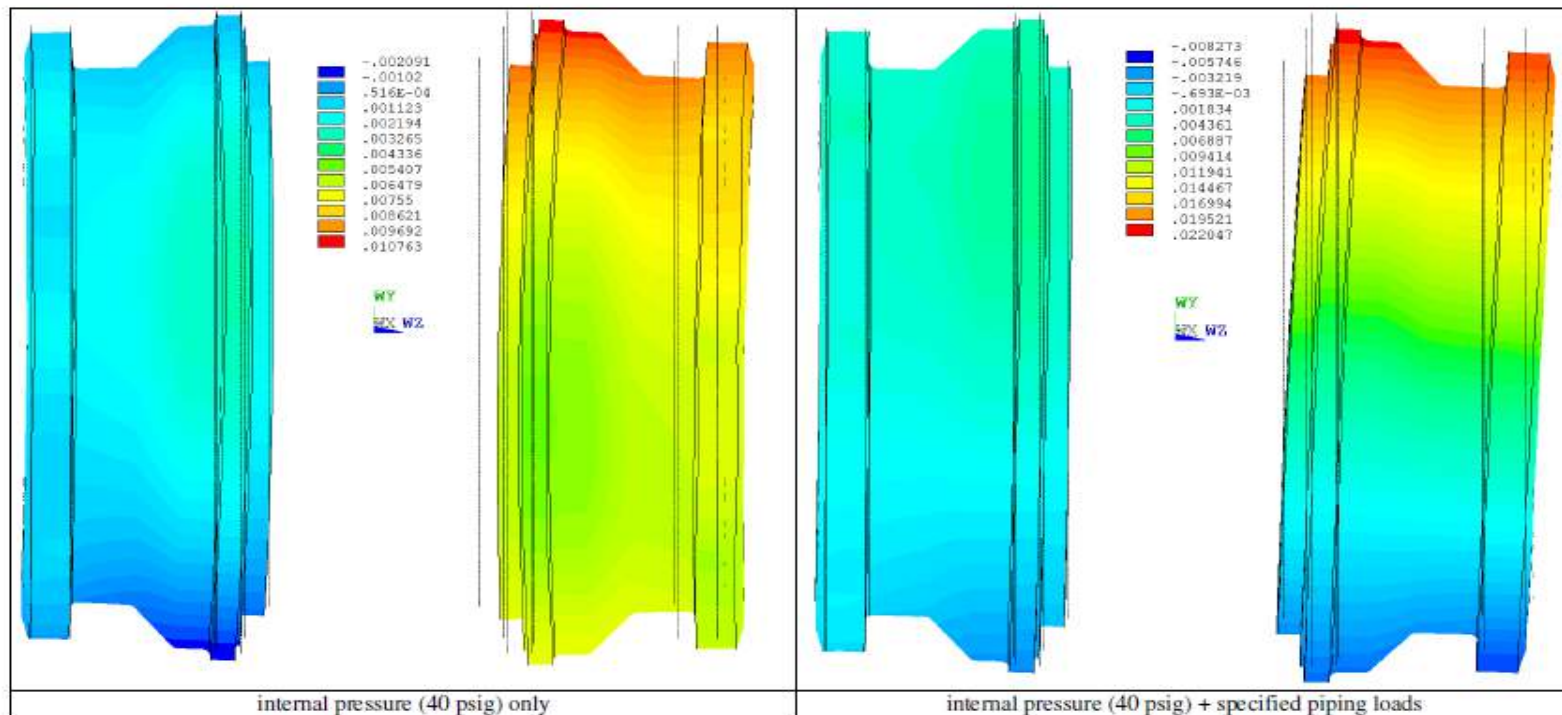
Thermal Profile

## Design Philosophy - Distortion Analysis



# Design Considerations, Methods and Characteristics

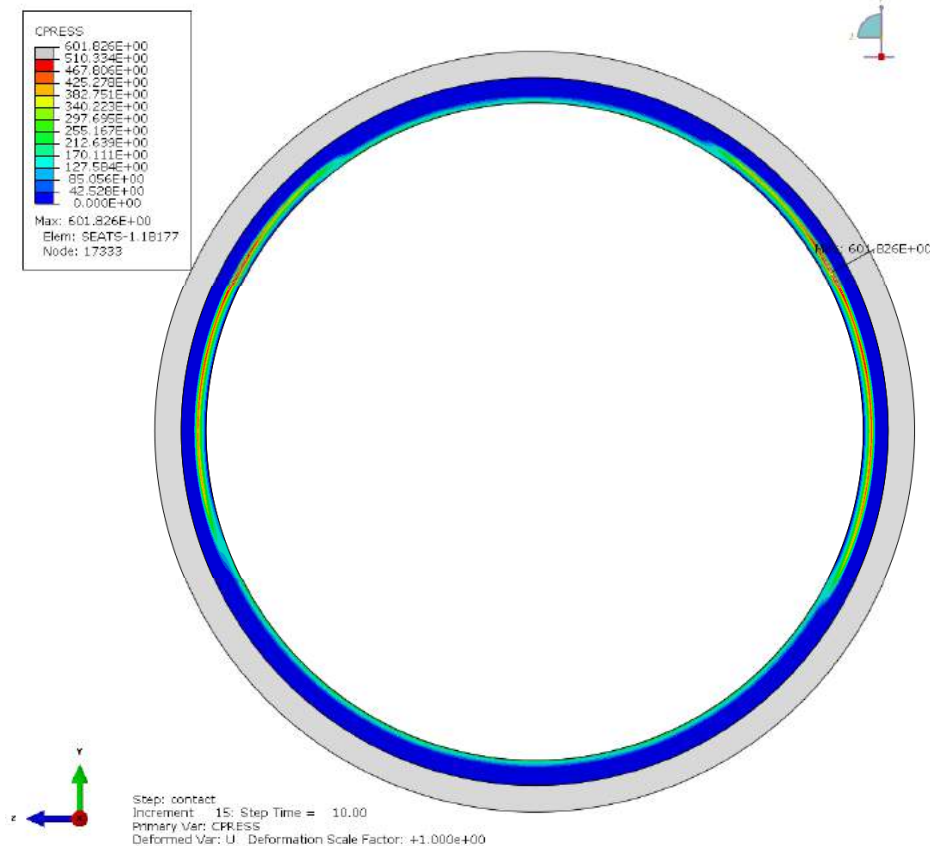
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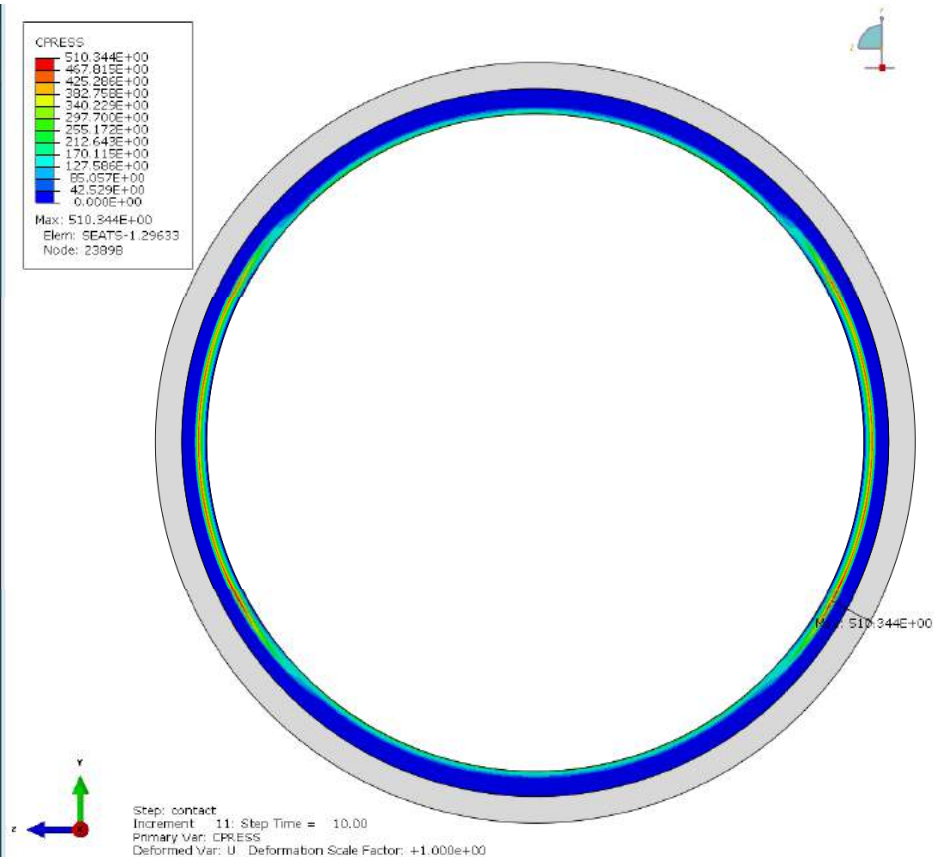
# Design Considerations, Methods and Characteristics

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## Contact Assessment FEA – Inlet Seats



**Design Pressure + Line Loads**



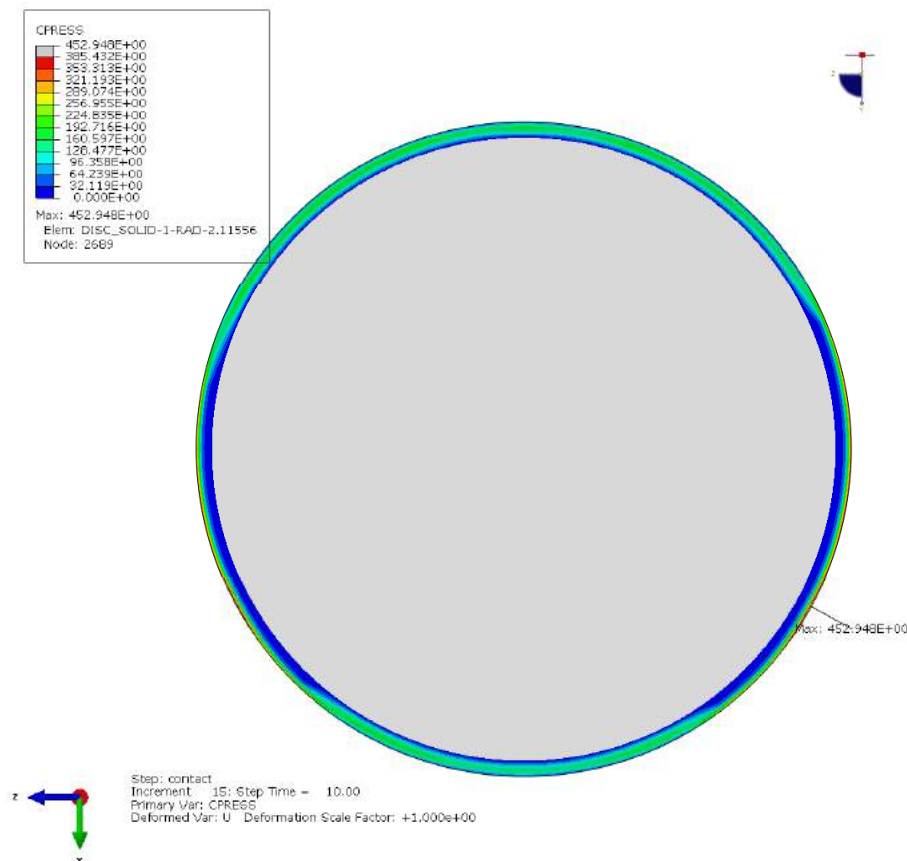
**Design Pressure**



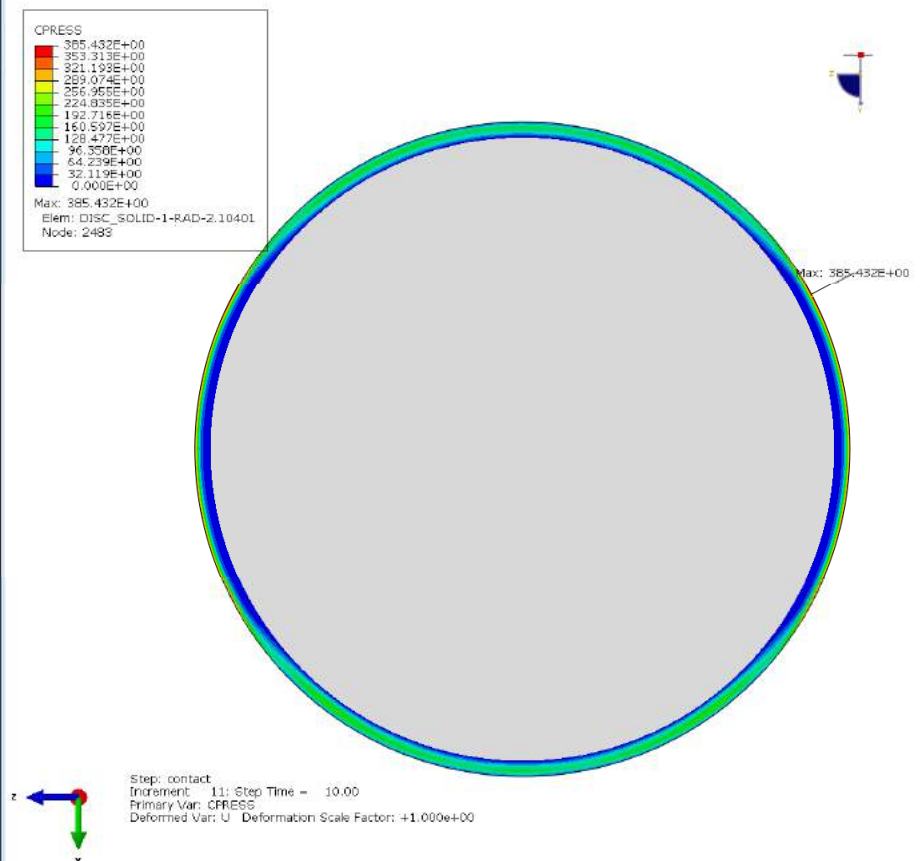
# Design Considerations, Methods and Characteristics

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## Contact Assessment FEA – Inlet Discs



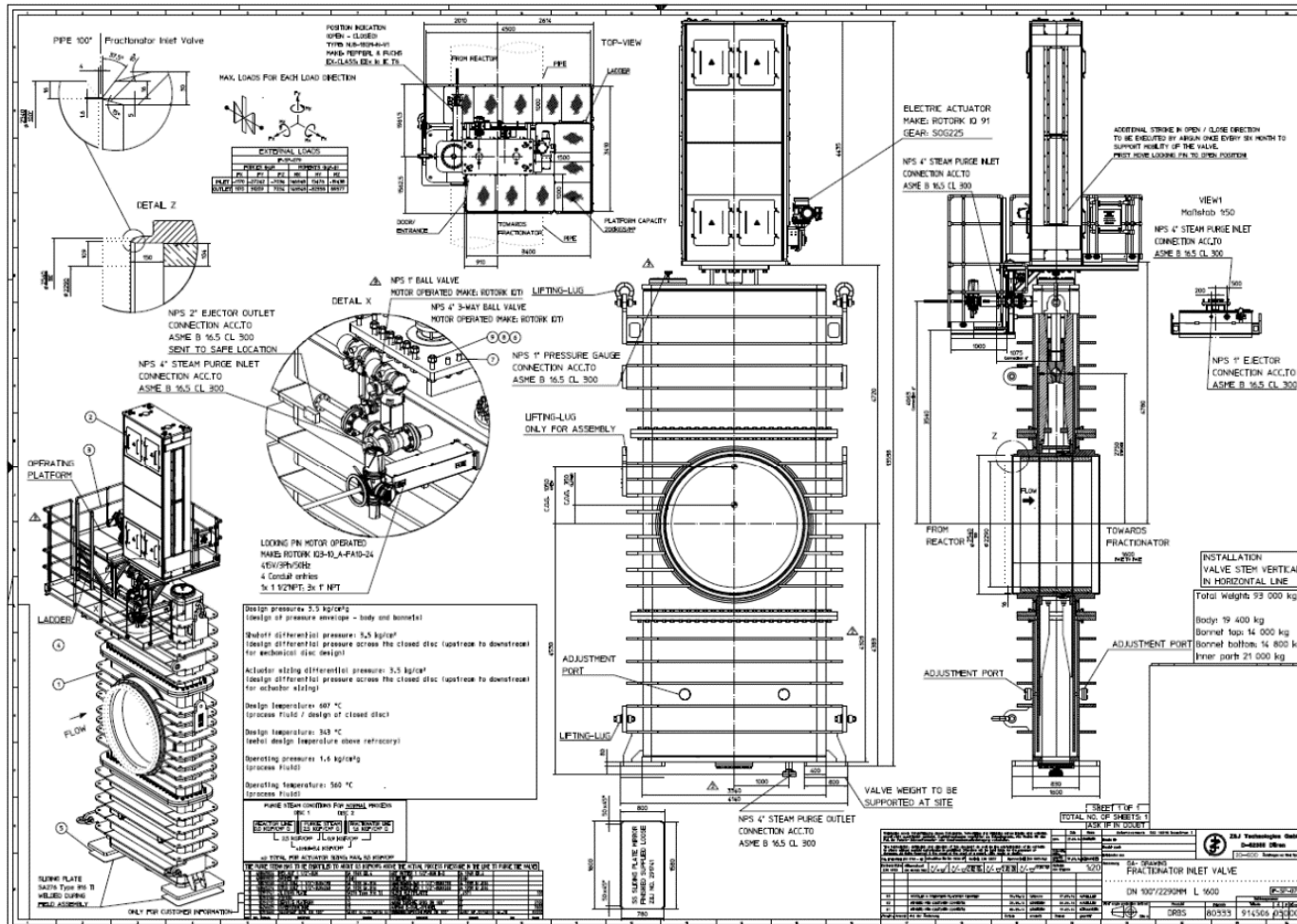
**Design Pressure + Line Loads**



**Design Pressure**

# FCC Reactor Overhead Line Vapor Isolation Valve

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**100" FCC Reactor Overhead Line Valve  
Design and Final Assembly**



# FCC Reactor Overhead Line Vapor Isolation Valve

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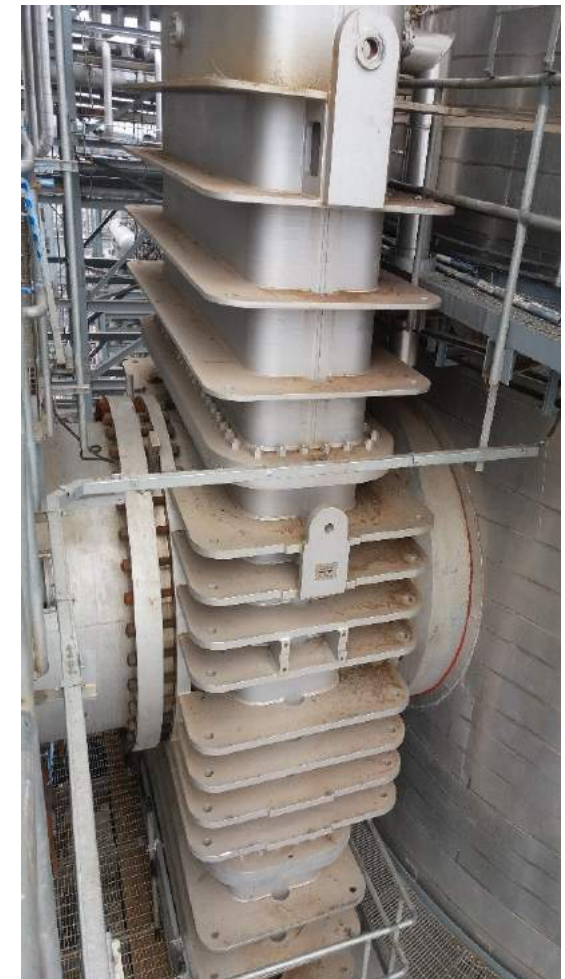
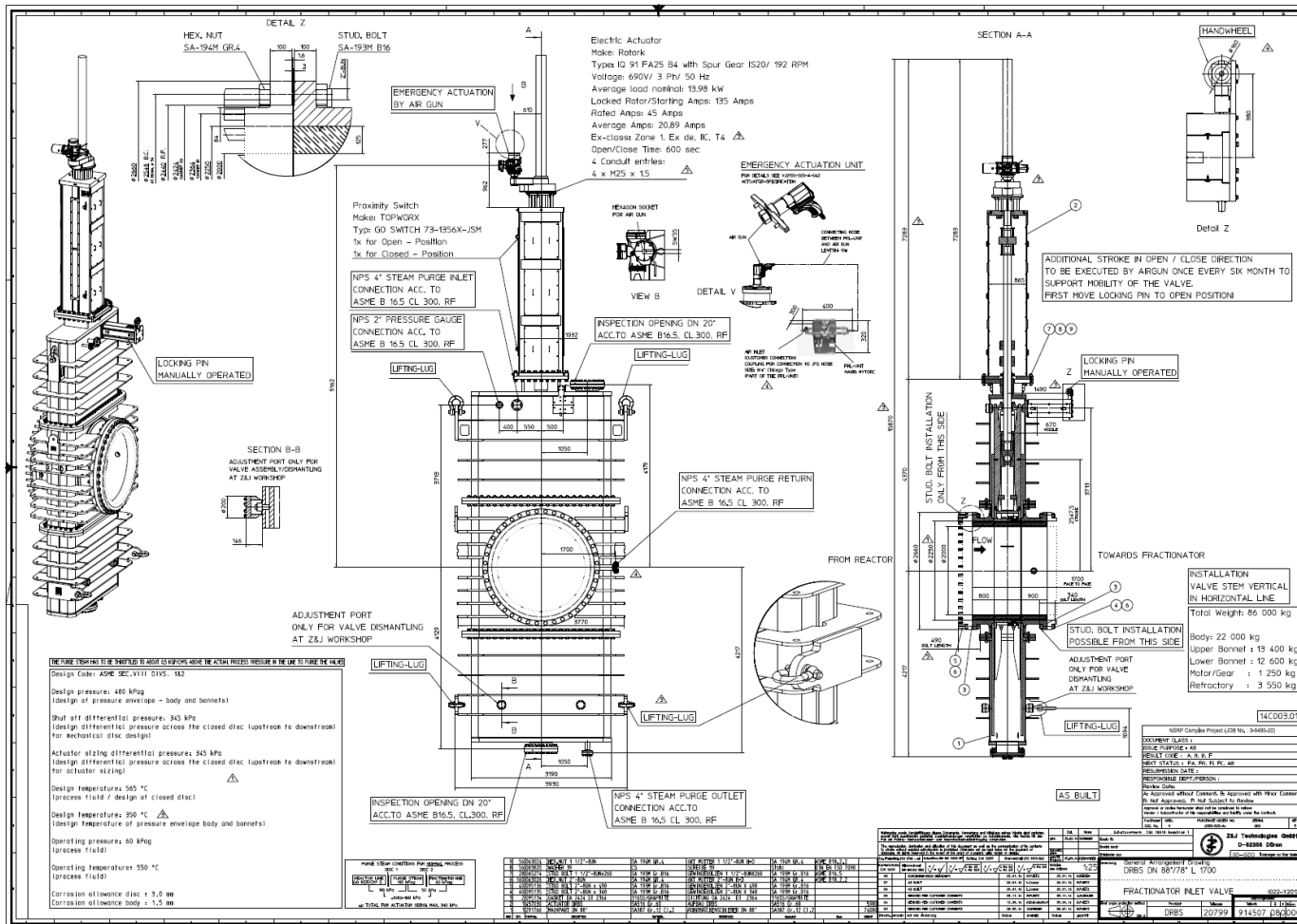


**100" FCC Reactor Overhead Line Valve Installation**

# FCC Reactor Overhead Line Vapor Isolation Valve

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## 88" FCC Reactor Overhead Line Valve Design and Final Assembly



# FCC Reactor Overhead Line Vapor Isolation Valve

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**88" FCC Reactor Overhead Line Valve Installation**

	Continent	Year Manufactured	Size	Design P		Design T		Operation
			in	psi	bar	°F	°C	Electric / Manual
1	North America	1994	36	50	3.45	1030	555	Manual
2	Europe	1995	16	40	2.76	890	477	Electric
3	Europe	1995	28	40	2.76	1022	550	Manual
4	North America	1997	48	31	2.14	1050	566	Manual
5	Asia	1998	78	59	4.07	1050	566	Manual
6	North America	1999	30	35	2.41	1050	566	Manual Bevel Gear
7	North America	2000	52	40	2.76	1150	622	Manual Bevel Gear
8	North America	2001	36	50	3.45	1050	566	Manual Bevel Gear
9	North America	2001	48	50	3.45	1020	549	Manual Bevel Gear
10	North America	2002	44	46	3.17	1050	566	Manual Bevel Gear
11	Europe	2003	48	60	4.14	1076	580	Electric
12	North America	2004	36	45	3.10	1200	649	Electric
13	North America	2005	30	50	3.45	1050	566	Manual Bevel Gear
14	North America	2005	48	45	3.10	1050	566	Manual Bevel Gear
15	North America	2005	24	45	3.10	1050	566	Manual Bevel Gear
16	North America	2005	66	45	3.10	1050	566	Manual Bevel Gear
17	Asia	2007	60	40	2.76	932	500	Electric
18	Asia	2007	78	60	4.14	1050	566	Manual Bevel Gear
19	North America	2008	48	45	3.10	1050	566	Manual Bevel Gear
20	North America	2008	48	45	3.10	1050	566	Manual Bevel Gear
21	North America	2008	60	45	3.10	1050	566	Manual Bevel Gear
22	Africa	2009	36	50	3.45	750	399	Manual Bevel Gear
23	Europe	2010	36	50	3.45	1050	566	Manual Bevel Gear
24	Asia	2010	72	50	3.45	1050	566	Electric
25	North America	2011	24	45	3.10	1025	552	Electric
26	North America	2012	26	50	3.45	1025	552	Electric
27	Europe	2012	26	50	3.45	1025	552	Electric
28	Asia	2012	66	56	3.86	1067	575	Electric
29	Europe	2012	30	50	3.45	1050	566	Electric
30	North America	2012 (x2)	50	50	3.45	1050	566	Electric
31	North America	2013	44	40	2.76	1025	552	Electric
32	North America	2013	42	50	3.45	1025	552	Electric
33	Asia	2013	100	50	3.45	1125	608	Electric
34	Asia	2014	88	70	4.83	1050	566	Electric
35	Europe	2014	60	66.7	4.60	1049	565	Electric
36	Asia	2015	75	79.8	5.50	1049	565	Electric
37	Asia	2015	42	79.8	5.50	1049	565	Electric
38	North America	2015	76	50	3.45	1050	566	Electric
39	North America	2016	52	45	3.10	1050	566	Manual Bevel Gear
40	North America	2016	36	75	5.17	1050	566	Electric
41	North America	2017	28	40	2.76	1025	552	Electric
42	South America	2017	30	48.3	3.33	1000	538	Electric
43	North America	2017	30	75	5.17	1050	566	Electric

## FCC Reactor Overhead Line Vapor Isolation Valve World Wide Reference List

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Thank you

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